Navy Personnel Research and Development Center
San Diego, California 92152-7250 TR-96-6 April 1996

Videoteletraining Delivery of a Quality Assurance Course with a Computer Laboratory

C. Douglas Wetzel
H. Lauren Pugh
Nick Van Matre
Steven W. Parchman

NPRDC-TR-96-6 April 1996

Videoteletraining Delivery of a Quality Assurance Course with a Computer Laboratory

C. Douglas Wetzel
H. Lauren Pugh
Nick Van Matre
Steven W. Parchman

Reviewed by
Orvin A. Larson

Approved by
J. C. McLachlan

Released by
P. M. Spishock
Captain, U.S. Navy
Commanding Officer
and
Murray Rowe
Technical Director

Navy Personnel Research and Development Center
53335 Ryne Road
San Diego, California 92152-7250

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATE COVERED
	April 1996	Interim

4. TITLE AND SUBTITLE
Videoteletraining Delivery of a Quality Assurance Course with a Computer Laboratory

5. FUNDING NUMBERS
Program Element: 0603707N
Work Unit: L1772.ET112

6. AUTHOR(S)
C. Douglas Wetzel, H. Lauren Pugh, Nick Van Matre, Steven W. Parchman

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Navy Personnel Research and Development Center
53335 Ryne Road
San Diego, CA 92152-7250

8. PERFORMING ORGANIZATION REPORT NUMBER
NPRDC-TR-96-6

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Chief of Naval Personnel (PERS-OOH)
Navy Annex
Washington, DC 20350

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Functional Area: Training Research
Product Line: Schoolhouse Training
Product Line: Distributed Training Technology

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE
A

13. ABSTRACT *(Maximum 200 words)*

A Quality Assurance (QA) course containing a student computer laboratory was delivered by videoteletraining (VTT). Two primary treatment groups were compared during four class convenings with a total of 100 students: (1) a VTT local classroom with an instructor and students, and (2) a VTT remote classroom where students were connected to the local classroom by a two-way audio and video VTT system. There were no significant group differences on a final examination and the scores were comparable with those for 133 students from traditional classrooms. Local and remote students were not significantly different on a quiz of facts on operating the computer program to produce a QA report in the laboratory. Few group differences were found on a student questionnaire. Small but significant differences were found on topics concerning the visibility of instructional aids, access to or attention from the instructor, and problems encountered during the computer laboratory. Remote students were less likely than local students to initiate interactions over the VTT network, but they participated equally when they were identified in instructor questions. The course was successfully delivered by VTT and could be expanded to other training sites. A cost analysis for two projected delivery sites indicated avoided student travel costs would be in excess of the combined costs for VTT classroom usage and computer equipment. VTT delivery techniques illustrated in this work include enhanced preparation of remote students prior to performing their laboratory work and the use of portable laptop computers with a wireless network that allowed the use of existing VTT classrooms.

14. SUBJECT TERMS
Military training, hands-on laboratory, computer laboratory, quality assurance, cost analysis, distance education, videoteletraining, interactive television, instructional television

15. NUMBER OF PAGES
79

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

Foreword

This report describes research conducted as part of the Navy Personnel Research and Development Center's Distributed Training Technology (DTT) project. The DTT project is part of our Classroom and Afloat Training research program and falls under the Education and Training project (L1772) of the Navy's Manpower, Personnel, and Training Advanced Development Program Element (0603707N). The work was performed under the sponsorship of the Bureau of Naval Personnel. The research evaluated training strategies and technologies to extend videoteletraining (VTT) beyond traditional, lecture-based courses.

The research investigated the feasibility of using videoteletraining to deliver a Quality Assurance course that contained a laboratory where students used computers. The findings have direct implications for the design of future distance education systems in the Navy and elsewhere.

The recommendations in this report are intended for use by the Chief of Naval Education and Training in developing policy for the application of VTT in the Navy.

P. M. SPISHOCK
Captain, U.S. Navy
Commanding Officer

MURRAY W. ROWE
Technical Director

Summary

Problem and Background

Many Navy personnel requiring training are geographically separated from training resources. Videoteletraining (VTT) enables an instructor to teach multiple classes at different geographic locations. VTT has been an efficient and cost beneficial way to deliver training and is in operational use by the Chief of Naval Education and Training (CNET) within the CNET Electronic Schoolhouse Network (CESN). VTT has been used for lecture-based instruction and additional cost savings could be achieved if other types of training such as student laboratories could be delivered by VTT. A Quality Assurance (QA) course presented a challenge to deliver by VTT because it contained a laboratory where students learned to use a computer program to produce a QA report. This required that remote-site students learn to use the program without the physical presence of the instructor and required the use of existing VTT classrooms not normally equipped for a computer laboratory.

Objective

The objective of this research was to evaluate the feasibility of using videoteletraining to deliver a Quality Assurance course containing a computer laboratory.

Approach

The approach to delivering the course by VTT included several adaptations of the laboratory procedures. An instructor software demonstration was developed to better prepare remote-site students for performing the computer laboratory with less assistance from the distant instructor. Portable laptop computer systems and a wireless printer network were used by remote-site students so that the laboratory could be conducted within existing VTT classroom facilities. An existing computer classroom was used by local-site students during the computer laboratory so that new computers were needed only for the remote site.

The evaluation of the course compared students in two primary treatment groups: (1) a VTT local classroom with an instructor and students, and (2) a VTT remote classroom where students were connected to the local classroom by a two-way audio and video VTT system. There were 48 local and 52 remote VTT students during four experimental convenings of the course. Training was transmitted from San Diego to the remote site in Pearl Harbor, Hawaii. The two VTT treatment groups were compared in terms of student questionnaire responses, an observer's tally of instructor-student interaction, and performance on a quiz covering facts about operating the computer program used in the laboratory. A comparison of student performance on an objective final examination included a third treatment group of 133 students who had previously been taught in traditional classrooms.

Results and Conclusions

There were no significant differences between local and remote students on the end-of-course final examination on the QA process. These scores were comparable with those of students in previous classes taught in a traditional classroom. There was no significant difference between the

local and remote students on the quiz covering facts about operating the computer program in the laboratory.

Student questionnaire responses generally showed few differences between the local and remote students. Significant differences between the groups were found in three topic areas. First, the visibility of instructional materials and training aids was rated slightly lower by remote than by local students. Second, access to, or attention from, the instructor was rated lower by remote students. Local students were more likely to cite the instructor as a frequent source of assistance, whereas remote students cited assistance from a combination of the instructor, VTT facilitator, and other students. Third, a group of questions indicated slightly greater problems for remote than for local students on aspects of the computer laboratory (i.e., operating the computer program and printing documents). However, the average difficulty ratings of remote students were in a positive direction and slightly above the portion of the scale indicating "few" problems. Remote and local students indicated a similar acceptance of VTT as a method of instruction on other questionnaire items.

The tally of interactions over the VTT network showed that instructor initiated questions during lectures were many times greater than when students were engaged in performing laboratory activities. Remote students initiated interactions less than local students, but remote students participated equally when instructor questions identified a specific site or student that should respond.

The QA course was successfully adapted for delivery by VTT and it is feasible to deliver the course in this manner. The course was delivered to remote students without significant problems, the evaluation measures revealed small differences between the groups, and the use of VTT was accepted by students and instructors. A cost analysis was conducted for the anticipated use of the computer equipment used in this research at two remote sites located at Pearl Harbor and Bangor, WA. Avoided travel costs to San Diego for 10 students from each of these two sites were compared with the costs of delivering the laboratory course by VTT. Avoided student travel costs for four class convenings were estimated to be $15,504 in excess of the VTT delivery costs (i.e., travel costs minus the sum of VTT classroom contract costs plus amortized computer costs). Additional class convenings where other courses shared the same computers would reduce the impact of the costs for outfitting VTT remote sites with computers.

Recommendations

The following recommendations are for the Chief of Naval Education and Training and the CNET Electronic Schoolhouse Network.

1. Delivery of the Quality Assurance course by videoteletraining has been successful and the use of this method should be expanded to other sites as appropriate to satisfy demand for the course.

2. Portable laptop computers should be used if more permanent installations cannot be made within VTT classrooms for this and similar courses.

Contents

List of Figures

Introduction

Problem

Many Navy personnel who must receive training are geographically separated from training resources. An increasingly efficient approach to meeting this requirement is needed as the Navy downsizes and training resources become constrained. Videoteletraining (VTT) has been found to be an efficient and cost beneficial way to address this issue because it enables a single instructor to teach multiple classes that are at remote geographic locations. The Chief of Naval Education and Training (CNET) has VTT in operational use in the CNET Electronic Schoolhouse Network (CESN). This VTT system utilizes an interactive two-way video and audio television system that allows distant *remote site* students to participate in the instruction originating from a *local site* where other students are co-located with the instructor.

VTT has generally been used for the delivery of lecture-based instruction. Even with current VTT technology, there is some reduction in the quality of the audio and video as compared with live instruction; e.g., it reduces the visibility of personnel at different classroom locations and also reduces the ability of instructors and students to interact as they do in a traditional classroom. These constraints make it more difficult to conduct training which is not instructor centered, such as a variety of courses with hands-on laboratories and learning environments that are highly interactive. Additional travel costs could be avoided if such training could be delivered via VTT rather than in traditional classrooms.

A training course on Quality Assurance (QA) presented a challenge for delivery by VTT because it contained a student laboratory that used computers. It is a relatively new course offering and student throughput is sufficient to warrant delivery by VTT. The three day course consists of lectures and two types of student laboratories. Several laboratory periods involve paper-based written exercises. Students create a quality assurance report during a computer laboratory using a program designed for this purpose. The ability of remote-students to learn to operate the program and obtain assistance was a concern because these students were not physically present with the instructor. The need to view the sequence of steps in operating the computer program also required an alternative approach to allow the computer screens to be shown over the VTT system. The use of existing VTT classrooms designed for lecture courses also required a solution that would accommodate the equipment used for a computer laboratory.

Objective

The objective of this research was to evaluate the feasibility of using videoteletraining to deliver a Quality Assurance course containing a computer laboratory.

Background

Previous research has demonstrated that VTT can be an efficient and cost-beneficial method to deliver training electronically to remote Navy personnel (Bailey, Sheppe, Hodak, Kruger, & Smith, 1989; Barry & Runyan, 1995; Rupinski & Stoloff, 1990; Rupinski, 1991; Simpson, Pugh, & Parchman, 1990, 1991a, 1991b, 1992, 1993; Stoloff, 1991; Wetzel, Radtke, & Stern, 1993, 1994). This research on the use of VTT in Navy training has shown that lecture-based courses can be

delivered by VTT without detrimental effects on achievement. Prior research on instructional television also indicates that student achievement is not affected by this method of delivery and that any initial unfavorable attitudes lessen as a result of experience with the medium (Wetzel, et al., 1993, 1994). The major cost benefits of video teletraining systems are in circumstances where travel and per diem costs are avoided by usage that is intense enough to offset the costs of the technology. Courses that are particularly beneficial in reducing travel costs are those with a high student throughput and which are short in duration (a week or less). Historical cost data developed by the CESN from 1989 through 1995 indicate that the system reaches the break-even point approximately half way through the year (i.e., VTT system costs are approximately half the travel and training costs that are estimated to have been avoided).

The use of VTT for a wider range of courses would extend the cost and efficiency benefits of VTT beyond the lecture-based courses that are delivered by VTT. A substantial amount of Navy technical training involves laboratories and hands-on activities. For example, a survey of Navy training administrators showed that about three fourths of their courses involved some form of laboratory and an analysis of actual training objectives showed that procedural learning was a very frequent objective (Wetzel, Van Kekerix, & Wulfeck, 1987a, 1987b). The purpose of the Distributed Training Technology (DTT) project was to develop training strategies that address the difficulties of using VTT for this kind of course content, such as hands-on laboratories. As part of the DTT project, the present study extends other work on adapting instructional content which presents challenges for VTT delivery. Prior work in this area with Navy courses includes the hands-on laboratories in a Damage Control Petty Officer course (Simpson, et al, 1992), performing computations and plotting in a Celestial Navigation course (Wetzel, 1995), hands-on laboratories and trouble-shooting in a Fiber Optic Cable Repair course (Wetzel, Radtke, Parchman, & Seymour, 1996), leadership training involving small group processes (Simpson, Wetzel, & Pugh, 1995; Wetzel, Simpson, & Seymour, 1995), and guidelines for converting courses to VTT (Simpson, 1993; Wetzel, 1996).

The approach to offering the QA course by VTT required instructional and technological adaptations to deliver the computer laboratory. The instruction was evaluated for changes that would enhance its visibility to remote students and better prepare them for conducting their laboratory work at a distance from the instructor. An instructor demonstration of the computer program was developed and the need to use a camera to show the computer screen was avoided by using a video scan converter. A permanent laboratory installation within the remote classroom was avoided by developing a portable computer system that used a wireless local area network.

The primary issues in evaluating the feasibility of the VTT version of the QA course were as follows: (1) can students learn new computer operation procedures at a remote classroom, (2) how well do remote-site students perform academically in the course compared with students who are in the local classroom with the instructor, (3) what effect did the VTT medium have on student attitudes toward the training, (4) what effect did VTT have on the level of interaction and participation for remote students compared with those at the local site, and (5) what practical efforts were required to deliver the VTT course that provided lessons learned applicable to other courses. Particularly, it would be desirable to apply the conversion techniques to other courses that also use computers.

Method

A description of the course, the treatment groups and outcome measures for the evaluation study, and the methods used to convert the course are given below. The outcomes of interest concerned a comparison of student knowledge on program operation, final examination scores, student attitudes toward the training, and the level of interaction in VTT courses.

Description of Course

The Afloat Quality Assurance course (J-651-0451) provides training in the use of a systematic program to ensure the quality of critical materials, components, and repair procedures for mission-critical and safety related systems on Navy ships. The training provides information on how to ensure that materials and procedures meet the appropriate standards and how to get appropriate authorization for any necessary deviations from the standards. The QA course is a three day course given at the Fleet Training Center in San Diego, CA and Norfolk, VA. The course is given about 12 times a year, with as many as 20 students per class. Estimated yearly throughput at the San Diego location is about 210 trainees. Instructors lecture during the first day of the course and during half of the second day. Students fill out various QA forms during paper-based laboratories on the second day of the course. This activity involves learning to use reference materials, evaluate hypothetical problems, and to document critical information. The instructor shows correctly completed forms at the end of these laboratories and the trainees self-evaluate their own work. A two-hour computer laboratory is given on the third day of the course prior to the final examination. Trainees produce a Control Work Package (CWP) document during the computer laboratory with a CWP computer program designed for this purpose. Trainees use the CWP program to enter data that will be printed in blocks on the document and to enter paragraphs for narrative sections of the report. Trainees print out the report for the instructor to review.

Treatment Groups

A single independent variable (type of instruction) with two states was used. This variable consisted of two treatment groups: (1) a VTT local classroom where students were with an instructor, and (2) a VTT remote classroom where students were connected to the local classroom by a fully interactive two-way audio and two-way video VTT system. A simulated remote VTT classroom arrangement was used for training instructors prior to delivering the course to actual remote students, but these simulated remote students were not included as part of the formal evaluation. Archival course final examination data were also collected for students who received the training in traditional non-VTT classrooms for comparison with the VTT students.

Outcome Measures

Dependent variables (outcome measures to assess the effect of the independent variable) were in three general categories: student academic performance, student perceptions of VTT and training quality, and instructor-student interaction. Each of these variables was defined in terms of the measures described below.

Student Performance

Three aspects of student performance were examined: (1) computer quiz percentage correct, (2) final examination percentage correct, and (3) percentage of students passing the course. The criterion for passing the QA course was a final examination score of 80 percent or greater. Student performance on computer laboratory assignments was not used by the instructors to determine final student course grades.

A 10 question quiz on computer procedures was developed for the purpose of this study. The quiz items were multiple-choice and true/false questions. The quiz covered the procedures involved in using the CWP computer program for quality assurance. At the end of the quiz there was space for students to make remarks regarding the computer laboratory part of the course. The quiz was given on the last day of the course after the computer laboratory was completed and immediately after the final examination was administered. A copy of the computer quiz is given in Appendix A.

The course final examination consists of 35 multiple-choice and fill-in test questions that require the student to check source material, evaluate hypothetical situations, and understand the QA process. It takes approximately 90 minutes to complete. The students take the final examination on the afternoon of the third day.

Student Questionnaire

A 47 item questionnaire was developed for the QA course (see Appendix B). The questions were organized in the following general categories: (1) instructors, (2) learning & classroom activities, (3) training aids, (4) interaction/participation, (5) overall course rating, (6) background and prior experience with the course material, (7) video-teletraining, and (8) open ended questions soliciting comments on VTT, what they liked or disliked about the course, and suggestions for improvements. Most of the questions (28 items) used a rating format where agreement or disagreement with a statement was rated on a five point scale ordered as follows: (1) Strongly Disagree, (2) Disagree, (3) Neither Agree/Disagree, (4) Agree, (5) Strongly Agree. There were four questions that asked students to rate the number of problems they encountered in portions of the course. These were rated on a four point scale ordered as follows: (1) No problems, (2) Few problems, (3) Some problems, (4) Many problems. There were two questions that asked students to rate their skill in computer use on a 5 point scale. There were also eight multiple-choice items and five open ended questions, one of which was a second part of a multiple-choice item.

VTT Interaction Tally

An observer recorded the frequency of instructor-student interaction between VTT sites during the three days of the course. The interaction tally was recorded for interactions that occurred over the VTT network and involved recording the frequency of events in several categories given below. Interactions had to be related to course content. Start and end times for each class period were recorded on the tally form to account for variations of these periods over different class convenings. A check mark was entered in a box corresponding to whether an interaction was associated with the local site or the remote site for each interaction category. The principal categories of interaction were whether a question was initiated by the instructor or by a student. The tally subdivided instructor questions (that were answered) according to whether the instructor left the question open

for any site to answer, named a specific site that should answer the question, or named a specific student to answer. Student questions were subdivided into those that were initiated by the student and those that extended into longer back-and-forth conversations and exchanges. Unanswered questions and reminders to local students to use their microphone were also recorded. These categories are fully defined in Appendix C. This interaction tally was used in previous studies by Wetzel (1995) and Wetzel et al. (1996).

Subjects and Classes Observed

Instruction was originated from the VTT local site at the Fleet Training Center (FTC) in San Diego, CA. The VTT remote site was located at the Fleet Submarine Training Center (NAVSUBTRACENPAC) FTC Detachment at Pearl Harbor, Hawaii. Simulated VTT remote classes (without an instructor present) were conducted in a second VTT classroom located in the same building as the local classroom at the FTC in San Diego. Traditional (non-VTT) classes were conducted at the FTC in San Diego.

Student grades were compared with a sample of 233 students who received similar training materials. These students were drawn from four convenings of the VTT class (48 local and 52 remote students) and from six convenings of the traditional class (133 students). For the classes studied, the average class size was 12 students for VTT local, 13 for VTT remote, and 22.2 for the traditional classes. Four of the six traditional class convenings took place prior to this study, and the student scores were taken from class records.

A subset of the total sample of 233 students completed questionnaires and were observed to record the interaction tally. Questionnaires were completed in four VTT class convenings (48 VTT local, 52 VTT remote students). Interaction tallies were recorded by observers for four convenings of the VTT class.

A breakdown of the proportion of officers and enlisted enrolled in VTT local, VTT remote, and traditional classes can be found in Table D-1 of Appendix D. It can be seen in Table D-1 that only about 11 percent of the students enrolled in the Quality Assurance class were officers. Table D-2 of Appendix D shows the average military rank for enlisted and officer students by treatment group. The typical officer student enrolled in this class was a Lieutenant Junior Grade or Lieutenant. The typical enlisted student was a Second or a First Class Petty Officer.

VTT Course Conversion

Conversion of the QA course for VTT delivery involved adapting course materials and training instructors in VTT delivery techniques. Instructor presentation materials were converted to a landscape hardcopy form and revisions were made to enhance the quality of numerous visuals. High quality still photographs of a mechanical valve were created so that identification marks inscribed on the valve could be seen in demonstrations presented over the VTT system. An instructor demonstration of the computer program was developed. It was delivered prior to conducting the student computer laboratory. The demonstration included a discussion of useful program operation tips.

A phased approach was used to refine the delivery of the course prior to delivering it to actual remote students. Instructors initially used the VTT system to practice delivering lectures. The VTT system was subsequently used to deliver several dry-run courses where students used the laptop computers. These were conducted in a simulated local-remote environment where the students in a class were divided among two local VTT classrooms during actual convenings of the course. This phased approach allowed instructors to view the training over the VTT system and to provide constructive feedback to one another. This arrangement also allowed the computer systems to be used by actual students and allowed the laboratory procedures to be refined prior to sending the equipment to the remote site.

The final phase of developing the VTT course involved going on-line to actual remote students located in Pearl Harbor from an originating classroom in San Diego. With the exception of the computer laboratory, both local and remote students received all instruction in the VTT classrooms. VTT local students left the VTT classroom during the computer laboratory and used an existing computer laboratory in another building at FTC San Diego. Remote students remained in the remote VTT classroom at Pearl Harbor during the computer laboratory. One of two QA instructors accompanied the local students to their laboratory and the other instructor remained in the local classroom to monitor remote students over the VTT system. A VTT facilitator was available at the remote site to assist students. A pair of students shared a laptop computer if there were not enough computers for individual use.

Computer Equipment

Laptop computers were used at the remote site because they are portable and can be moved in and out of VTT classrooms that must be used for other VTT courses. This avoided having to dedicate a classroom to a computer laboratory. An infrared wireless local area network (LAN) was used with the laptop computers to reduce a clutter of wiring in the classroom. The wireless LAN was used to communicate with a conventional personal computer that acted as a print server. A laser printer attached to this computer allowed students to print out a hardcopy of the QA report produced during the laboratory.

The computer equipment and software used in this research are listed in Table E-1 of Appendix E. Ten laptop computers were provided for students at the remote-site laboratory. This accommodated a maximum of 20 students when each computer was shared by a pair of students. One laptop computer was provided at the local transmitting site for the instructor demonstration. Students used the computers on the existing desks in the remote classroom. The electrical supply for AC/DC converters used to supplement the battery powered computers was provided through low profile power cords to avoid hampering foot traffic. A mobile cabinet with lockable doors was used to house the computers when not in use.

A scan converter was used so that computer screens could be converted to video and transmitted over the VTT system. This device electronically converts computer VGA video to NTSC video. Typical computer monitors are difficult to show with a video camera because the frequency mismatch of these two devices produces a crawling band across the screen. The scan rates for some laptop computer screens do not cause this problem, but they can cause reflections from lighting within the room and be difficult to position in front of a camera.

The scan converter allowed the instructor to demonstrate the operation of the computer program to students prior to their use of the program during the laboratory period. Although the resolution provided by the scan converter was less than that of the computer display, it was sufficient to provide a general orientation and to show the sequence of operations when accompanied by the instructor's verbal description. The capability also allowed the instructor to answer student questions on operating the program during the computer laboratory sessions. The instructor would locate the particular point in the program where the student was encountering difficulties and show that screen over the VTT system. The difficulty of an exclusively verbal exchange was reduced because the screen provided participants with a visual reference of the material being discussed.

VTT Classroom Equipment

The VTT classrooms were equipped with a fully interactive two-way video and two-way audio digital VTT system. Digital video was transmitted at 384 Kbps using a VTEL brand 386 MediaMax Codec and Multipoint Control Unit. Students viewed all instruction on two large TV monitors located in the front corners of the classroom (40" or 45" diagonal monitors). Two 25" monitors at the back wall of each room showed a view of the outgoing video and the incoming video from the other site. Students were instructed in the use of the VTT system on the first day of class. Each pair of students at a desk shared a push-to-talk microphone that was used to talk to other sites over the VTT network. Students in the local classroom were reminded to use the push-to-talk microphones so that remote sites could hear them.

The outgoing video from a classroom was selected with a hand-held remote control that allowed switching among several camera sources: a view of the instructor from a camera on the rear wall of the room, a view of students from a camera mounted on the front wall of the room, a videocassette recorder (VCR), and one of several video sources located at the instructor podium. A manual six-input video switch attached to the instructor podium at the local site allowed one of several devices to be selected as the outgoing video from that location. The primary device used at the podium during typical lecture-based courses is a video document camera on an easel copy stand. This device is used to show hard copy materials or small demonstration items. The VTT classrooms were not equipped with chalkboards or whiteboards. The other video source switched from the podium during this course was the scan converter used to show the screen of the instructor's laptop computer.

Results

The treatment groups were compared on student performance in the course, student responses on the post-course questionnaire, and participation patterns from the interaction tally. The number of students for the analysis varied slightly over these different outcome measures (cf. Appendices D and F). Results for all data collection measures were available for the two VTT groups. The most important comparisons in these data are between these two VTT groups because they attended exactly the same classes, whereas the traditional students attended separately convened classes. A cost analysis that incorporates the expense for computer equipment is provided at the end of the results section.

Student Performance

Student performance was assessed with three measures: percentage correct on the computer quiz, percentage correct on the final examination, and the proportion of students passing the course. The ratio of officer to enlisted students was approximately the same in the treatment groups (11% were officers over all groups). The results are therefore presented without distinguishing between officer and enlisted scores (breakdowns for these subgroups are given in Appendix D). The treatment groups in these comparisons consisted of 48 VTT local, 52 VTT remote, and 133 traditional students. The three groups were compared for the final examination and percentage of students passing the course. No computer quiz data were available for traditional students.

Computer Quiz

The average percent correct on the computer quiz is shown in Figure 1. The mean of the VTT local students (46.5) is less than one percent higher than the mean of the VTT remote students (45.7). A one-way analysis of variance showed that the difference between these two means was not significant, $F < 1, p > .05$.

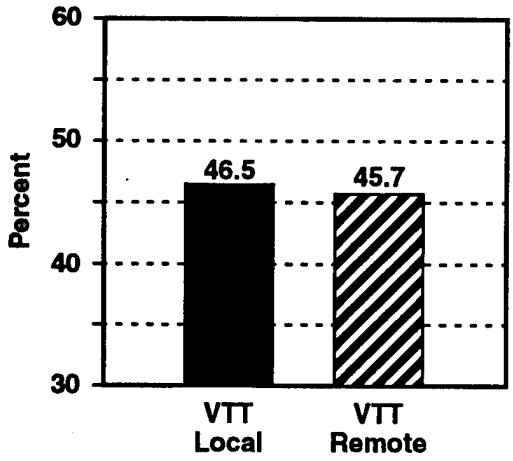

Figure 1. Average percent correct on computer quiz.

A remarks section was provided at the end of the computer quiz. Tables F-3 and F-9 in Appendix F give the percentage of treatment group responses to this request for remarks. Only 14.3 percent of the VTT local students commented in the remarks section, while 38.3 percent of the VTT remote students made comments in this section. A Chi Square test showed that the frequency of providing a response was significantly different between the two groups ($\chi^2(2) = 4.44, p < .05$). Most of the VTT local student comments were positive comments on the course or the computer program, whereas most VTT remote student responses were complaints regarding difficulties with the computer software. The methods available for printing documents changed over the course of the study and the level of student complaints may reflect these differences. For example, local students printed directly to a printer during some laboratories; during other laboratories the instructor printed the documents from a floppy provided by the student. Remote students always

printed via the LAN and the infrared devices needed to be repositioned during the study to enhance reception for varying student station locations within the room.

Final Examination

The average percent correct on the final examination is shown in the left hand panel of Figure 2. The means for the traditional and the VTT local students are almost exactly the same (traditional, 93.9; local, 93.8). The average percent correct for VTT remote students was only about 2 percent lower than the scores for the other two groups (remote, 91.9). A one-way analysis of variance showed that the differences among these means were not significant, $F(2, 230) = 1.94, p > .05$. The average percent correct on the final examination for all students was 93.4.

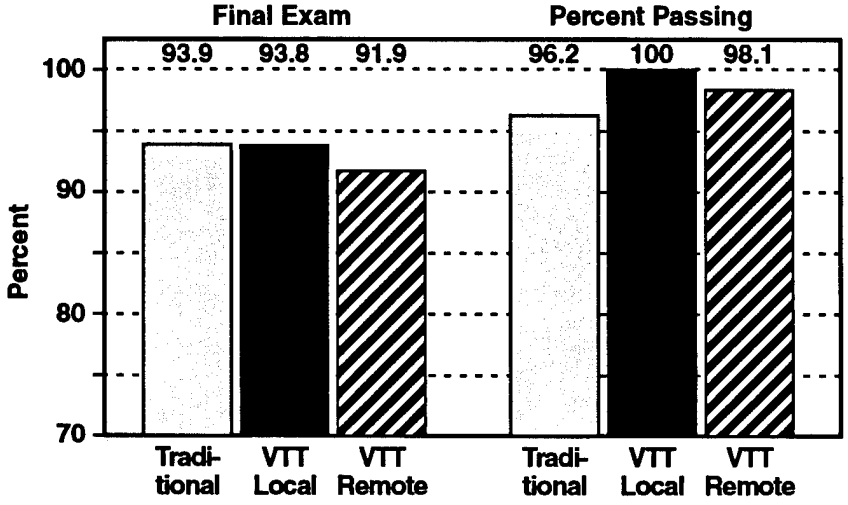

Figure 2. Average percent correct on course final examination and percentage of students passing the course.

Percent Passing Course

The percentage of students passing the course is shown in the right hand panel of Figure 2. Students passed the course if they received a score of 80 percent or better on the final examination. Computer quiz scores were not included in the criteria for passing the course. Of the 233 students included in this study, only 6 students (2.6%) did not pass the course. Of the 133 students in the traditional classes, five students (3.8%) failed to pass the course. One of the 52 remote students (1.9%) did not pass the course. All 48 local students passed the course.

The data for students passing the course were evaluated with a test of the proportion passing (Fleiss, 1981, p.139). The proportion of students passing in the three groups did not differ significantly ($\chi^2(2) = 2.10, p > .05$).

Discussion of Performance

None of the performance measures showed a significant difference between any of the treatment groups. VTT local and remote students performed at a similar level on the computer quiz. Performance on the final examination was at a high level for all three groups of students. The very small differences among the treatment groups on the final examination were not significant. The number of students passing this course was high, and the number of students who failed was negligible in the VTT groups.

These results indicate that the QA course can be taught successfully by VTT. Performance on the computer quiz was not at a high level for either remote or local student groups. This result may be explained by a combination of the following: (1) the quiz contained questions that were too technical for inexperienced computer users; (2) students knew that the quiz did not contribute toward their final grade; (3) the overall emphasis in the course is on QA content, while the computer quiz emphasized procedures for inputting and retrieving data.

Student Questionnaire

Student evaluations of the VTT training were measured with a post-course questionnaire (Appendix B). The questionnaire was completed by a total of 100 students (52 local and 48 remote) from the four VTT class convenings.

Student Prior Experience

Items 30-32 asked students about their prior experience with quality assurance concepts and the use of computers.

Item 30 asked students to rate their agreement/disagreement with the statement "Before this course, I had basic knowledge of quality assurance concepts and forms." A five point scale was used: (1) strongly disagree, (2) disagree, (3) neither agree/disagree, (4) agree, (5) strongly agree. Student responses were near the midpoint of the scale. The average for VTT local was 2.81, and the average for VTT remote was 3.13. An analysis of variance showed no significant difference between these two groups, $F(1,93) = 1.47$, $p > .05$. The Pearson correlation between responses to Item 30 and student percent correct performance on the final examination was negligible ($r = 0.145$, $df = 93$, $p > .05$).

Item 31 asked students to rate their general skill or background on using computers on a five point scale: (1) None/Beginner, (2) Novice, (3) Intermediate, (4) Accomplished, (5) Advanced. Students who clearly indicated a low level of background skill with computers (None/Beginner) comprised 21 percent of both groups combined. An analysis of variance showed that the means of the two VTT groups (local 2.81 and remote 2.43) were not significantly different, $F(1,97) = 2.81$, $p > .05$. There was a weak but significant correlation between ratings on this question and the percent correct score on the computer quiz ($r = 0.248$, $df = 97$, $p < .05$).

Item 32 had students rate their level of typing or keyboard skill on a five point scale: (1) Hunt-and-peck, (2) Beginner, (3) Intermediate, (4) Accomplished, (5) Advanced. Students who clearly indicated a low skill level in typing (Hunt-and-peck) comprised 17 percent of both groups

combined. An analysis of variance showed that the means of the two VTT groups (local 2.50 and remote 2.67) were not significantly different, $F < 1$, $p > .05$. Scores on the computer quiz and ratings on this item were essentially uncorrelated ($r = 0.064$, $df = 97$, $p > .05$).

The responses to the three background questions (30, 31, and 32) indicated that students had some general familiarity with the ideas and skills that are presented in this course. The average student in this course rated his or her skills a little less than "intermediate" and about a fifth of the students gave responses at the lowest computer skill level. The two treatment groups had similar backgrounds, and performance in the course was generally not related to students' assessment of their previous experience.

Student Ratings

Students rated a series of statements that fall into the following four categories: instructors, learning activities and training aids, interaction/participation, and Video-Teletraining (Items 1-22, 33-36 in Appendix B). These statements were rated on a 5-point scale with a midpoint of 3 using the following scale values and labels: (1) strongly disagree, (2) disagree, (3) neither agree/disagree, (4) agree, and (5) strongly agree. There were also five items that asked students to rate the extent of problems encountered during specific course activities (Items 24-28). These statements were rated on a 4-point scale: (1) no problems, (2) few problems, (3) some problems, (4) many problems.

Figures 3, 4 and 5 show the mean ratings for VTT local and VTT remote students for items that were rated on a five-point scale. Students gave positive ratings for the dimension being measured and the average rating for most items is slightly above the "agree" region of the scale. The wording of the statement in Item 21 results in a low value that still reflects a positive rating because of the wording of the statement.

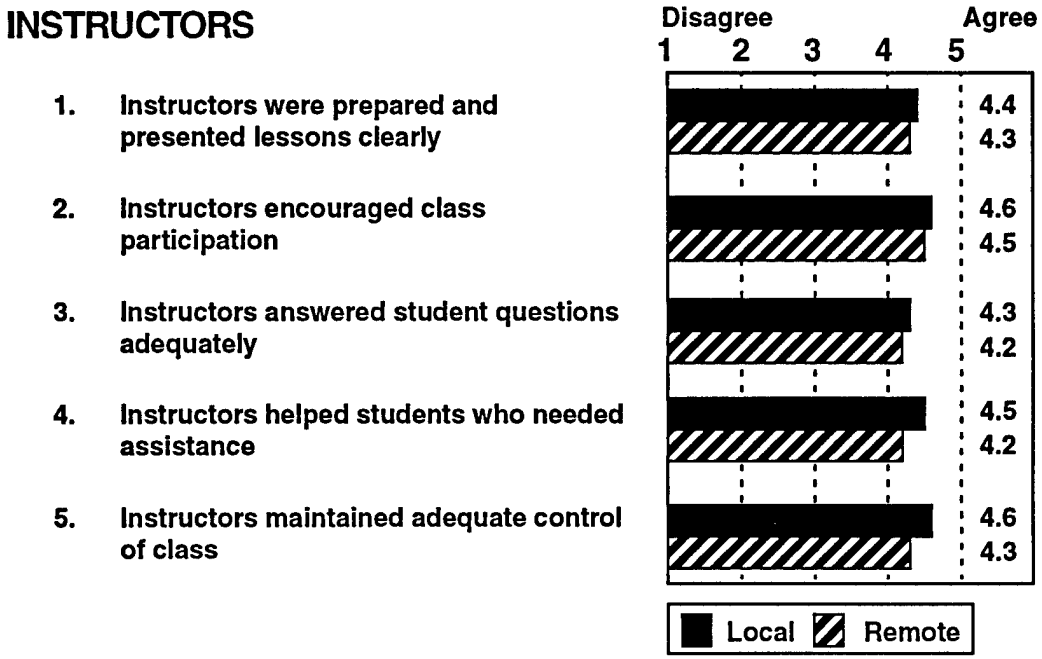

Figure 3. Student ratings on instructors (Items 1-5).

LEARNING ACTIVITIES & TRAINING AIDS

6. I could clearly see the instructional materials presented by the instructor
7. I could clearly hear the instruction
8. The course provided skills that can be applied on the job
9. I had access to the instructors outside of class concerning the course content
10. Instruction and demonstrations on completing the forms was adequate
11. Instruction and demonstration of computer procedures was adequate for the computer lab
12. Paper and pen exercises were completed without problems
13. The computer laboratory was accomplished without problems
14. Training aids were used effectively
15. Details of training aids could be clearly seen (for example, transparencies/ graphics/forms)
16. Table space and room layout were adequate to accommodate the use of computers

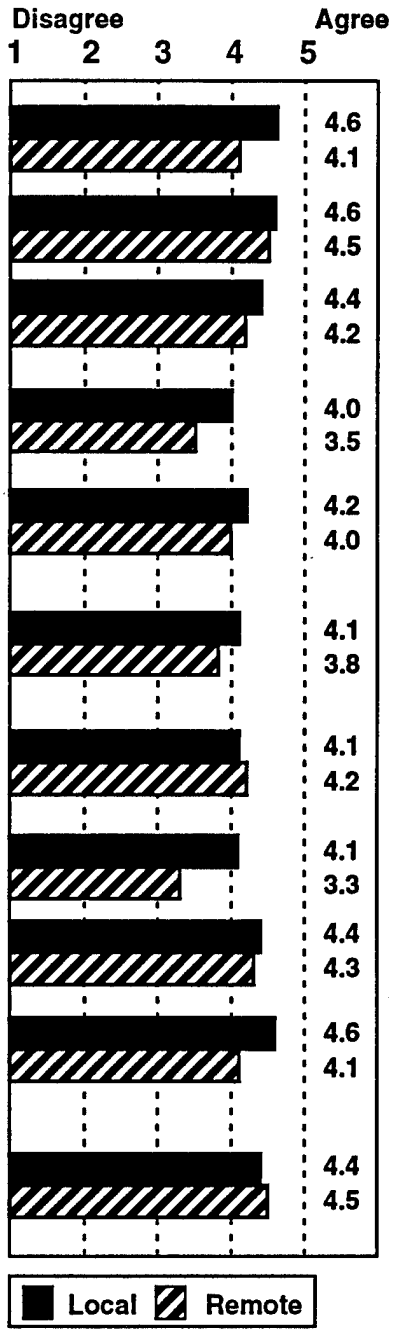

Figure 4. Student ratings on learning activities and training aids (Items 6-16).

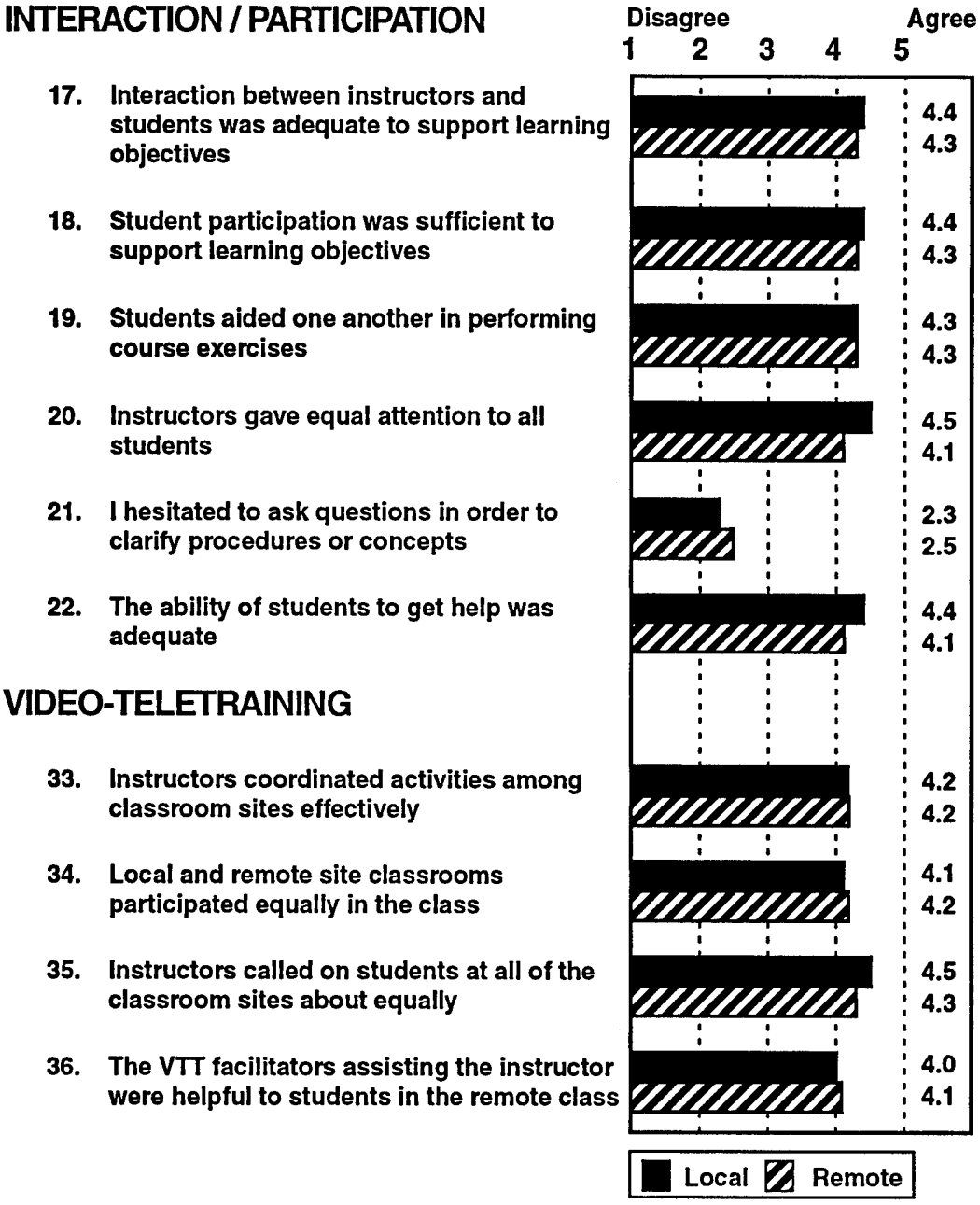

Figure 5. Student ratings on interaction, participation, and video teletraining (Items 17-22 and 33-36).

A one-way analysis of variance was computed for each item to determine the statistical significance of rating differences between the VTT local and remote treatment groups. A significant difference between groups was found with only 11 of the rating items. The degrees of freedom and F values for these tests, along with an indication of significant differences, are given in Table F-1 of Appendix F.

Ratings for the instructors were assessed in Items 1-5 (Figure 3). The ratings for these items were generally high (above 4.0) and there were no significant differences between groups on the first four items. Only Item 5 revealed a significant difference between groups. Although both groups gave high ratings to Item 5, remote students rated instructor control of the class almost one third of a unit lower than did local students.

Items 6-16 addressed learning activities, training aids, and audio-visual adequacy (Figure 4). Significant group differences were found with four of these items (6, 9, 13, and 15). The ability to see the instructional materials and details of the training aids was rated about one half of a rating point lower by remote students than local students (Items 6 and 15), although ratings were still high for both groups. Remote students rated their access to instructors outside of class (Item 9) about one half a rating unit lower than did local students. That differences on this item were not greater may be related to the observed efforts on the part of the instructors to remain on camera for a time during breaks and at the end of class. Remote students gave lower ratings than local students in agreeing that the computer laboratory was accomplished without problems (Item 13). Remote student ratings were about three quarters of a rating point lower and just above the middle of the scale. Other aspects of the computer laboratory are considered below.

Interaction, participation, and related VTT issues were addressed in Items 17-22 and 33-36 (Figure 5). There was little indication of problems in these areas. Ratings for all but one item were slightly above four on the scale. Only two items yielded a significant group effect, with differences of about a third of a rating unit (Items 20 and 22). Remote students gave a lower rating than did local students to the statement that instructors gave equal attention to all students (Item 20). Remote students rated the ability of students to get help lower than did local students (Item 22). The negative phrasing for Item 21 produces a low rating value which indicates that students in both groups disagreed that they hesitated to ask questions.

Items 24-28 concerned problems encountered by students during specific course activities (Figure 6). These items were rated on the following four point scale: (1) no problems, (2) few problems, (3) some problems, and (4) many problems. There were significant differences between the group averages for all but one (Item 25) of these five items. The local students remained consistent in giving a rating of about 1.5 for each item, thus indicating very few problems. Remote students tended to rate these items from one third to three quarters of a rating point higher than local students, indicating that these students perceived at least a few problems in each area.

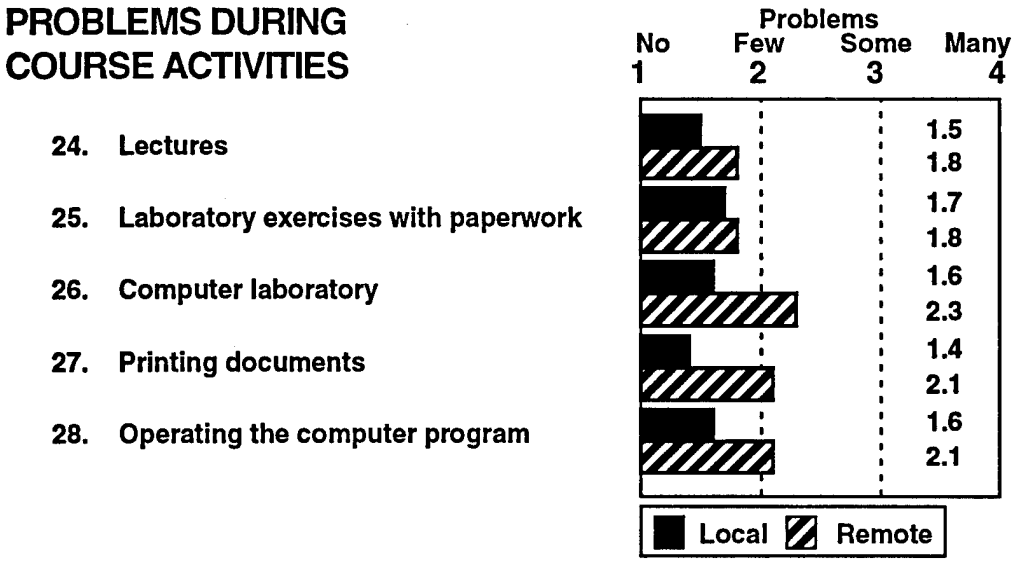

Figure 6. Student ratings on problems encountered during specific course activities (Items 24-28).

The smallest differences between groups concerned problems during lectures and paperwork laboratory exercises (Items 24 and 25). Of these two activities, only lectures were rated as having significantly more problems by remote than local students (one third of a rating point). Slightly larger group differences were found with the three rating items on the computer laboratory (Items 26, 27, and 28). Remote students rated significantly more problems than local students for the computer laboratory overall (two thirds of a point), for problems in printing documents (three quarters of a point), and for operating the computer program (about one half a point). Despite the higher reported incidence of problems for remote students, their ratings were still within the region of the scale labeled "few" problems.

Multiple-choice Items

Items 29 and 37-43 were given in a multiple-choice format to assess student sources of assistance, opportunities for interaction, and preferences on aspects of instructional delivery methods. Percentages of response to each choice were calculated for local and remote groups and Chi Square tests were used to test for significant group differences in the distribution of responses.

Items 29, 37, and 39 provide information on the source of assistance and opportunities for interaction for students. Figure 7 shows that the pattern of responses of how students worked at the computer was similar for local and remote students (Item 29). A Chi Square test showed that the distribution of responses was not statistically different for the two groups of students ($\chi^2(3) = 5.82$, $p > .05$). There was a tendency for remote students to be on a team where the members took turns operating the computer program more often than there was for local students (54.9% versus 29.7%).

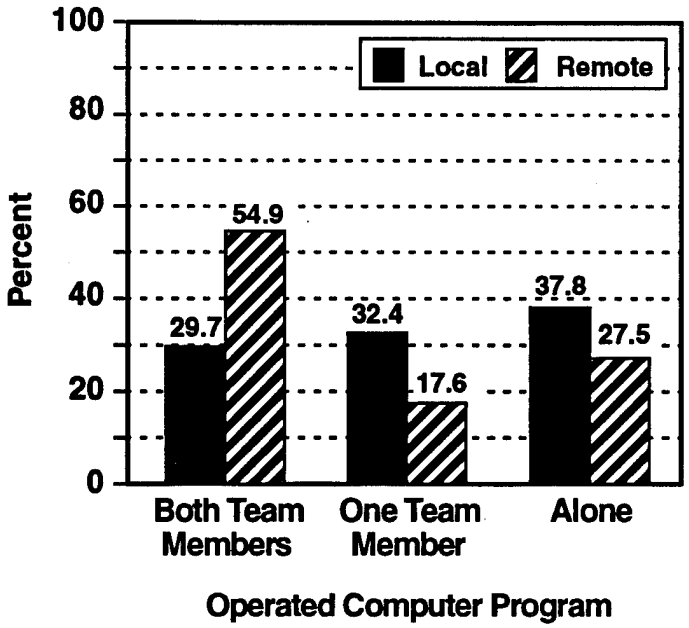

Figure 7. Student responses on who operated computer program during laboratory (Item 29).

Student indications of who most frequently provided them with assistance are shown in Figure 8 (Item 37). It can be seen that a larger proportion of local students (74.5%) than remote students (43.1%) reported that the instructor most frequently provided assistance. Remote students were more likely than local students to cite the assistance of the facilitator (23.5% versus 0%) and other students (21.5% versus 12.8%). A Chi Square test showed that the distribution of responses was significantly different for the two treatment groups ($\chi^2(3) = 16.30, p < .05$).

In responding to Item 39, most students (71% overall) indicated that their opportunities to interact with the instructor were not affected by the use of VTT for the instruction. Figure 9 shows that the pattern of responses for local and remote students was similar in judging how their opportunities for interaction with the instructor were affected by VTT. A Chi Square test showed that the difference in the distribution of responses was not statistically significant for the two groups ($\chi^2(2) = 4.07, p > .05$).

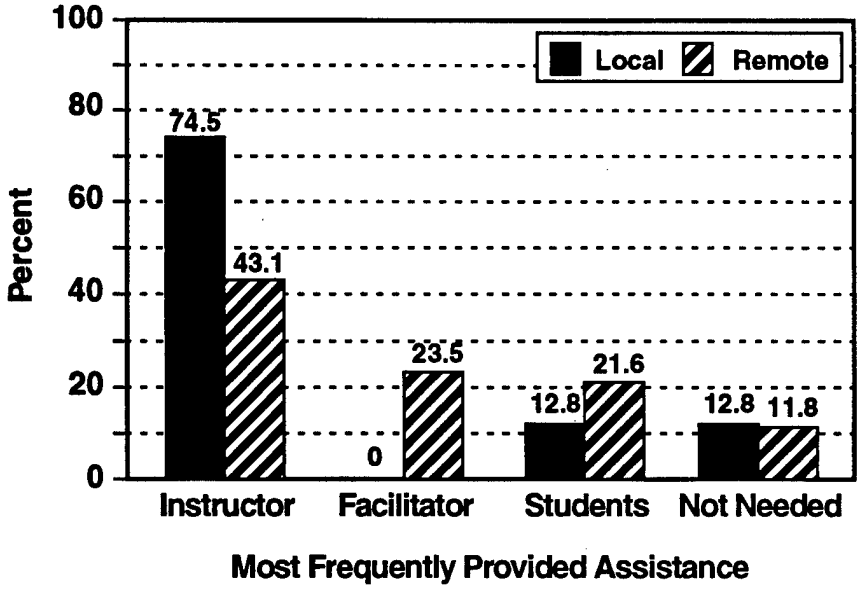

Figure 8. Student responses on who most frequently provided assistance (Item 37).

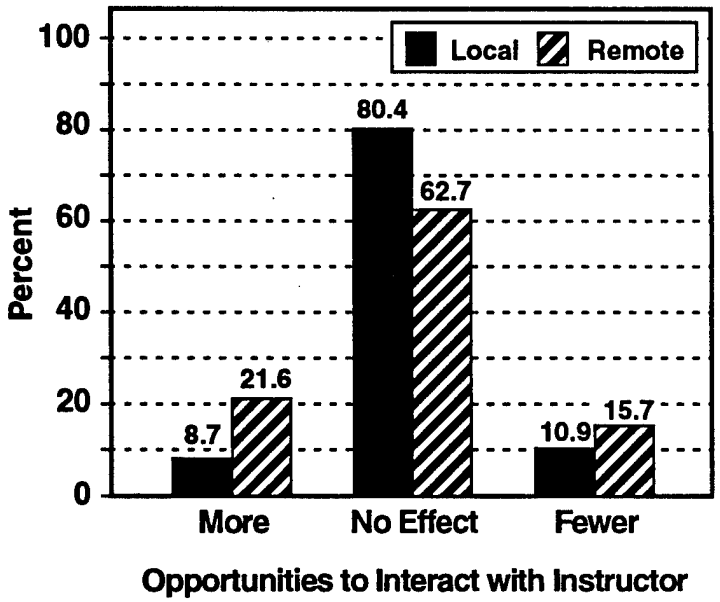

Figure 9. Student perceptions of opportunities to interact with the instructor (Item 39).

Items 38, 42, and 43 examined student preferences for a method of instruction and whether students perceived problems with VTT instruction. Figure 10a shows that local and remote students had similar response patterns when asked for their preference for a method of instruction (Item 38). A majority of students in both groups responded that they would accept either method of instruction. A Chi Square test showed that the differences in distribution of responses was not statistically significant for the two groups ($\chi^2(2) = 2.66, p > .05$). There was only a slight tendency for remote students to express a greater preference for the VTT method of instruction (a significant effect in this direction was found in previous studies; Wetzel 1995; Wetzel, et al, 1996).

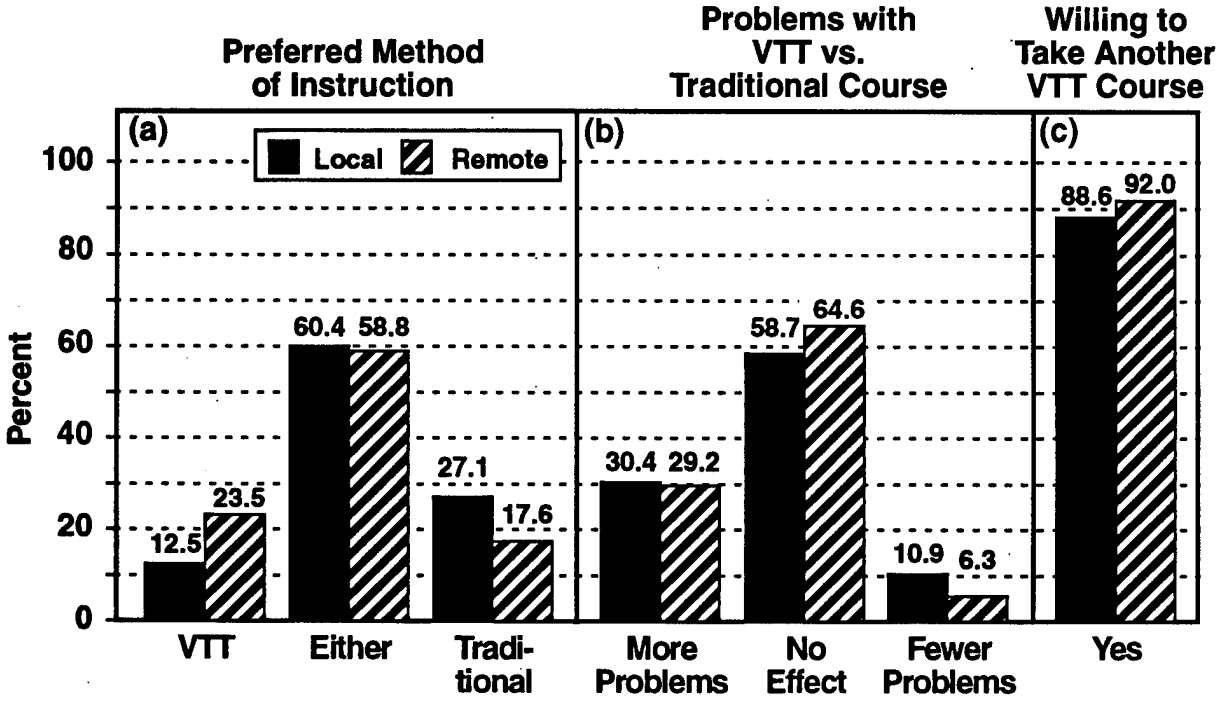

Figure 10. Student preference for method of instruction, perceived problems with VTT delivery, and willingness to take another VTT course (Items 38, 42, and 43).

Item 42 asked whether students thought there were more or fewer problems as a result of delivering the course by VTT instead of by the traditional method. As shown in Figure 10b, most students in both groups responded that the VTT method had no effect on problems encountered in the course, and both groups had very similar over-all response patterns. A Chi Square test showed that the distribution of responses was not significantly different for the two groups ($\chi^2(2) = 0.73$, $p > .05$).

Figure 10c shows that approximately 90 percent of the students in each of the groups indicated that they would take another VTT course if given the choice (Item 43). A Chi Square test showed that the distribution of responses was not significantly different for the two groups ($\chi^2(2) = 0.31$, $p > .05$). This question also asked students to "please explain" their response and these written comments were clustered into related categories (Table F-3 and F-4 in Appendix F). About half of the students in each group responded to the question. There were only slight differences between

the groups in offering comments that were positive (30% local; 38.5% remote) or negative (26% local; 19.4% remote). Positive comments included saving money or travel, interacting over the VTT system, and liking or enjoying VTT. Negative comments cited a preference for traditional instruction and VTT equipment or procedural problems.

Figure 11a shows responses to Item 40 where students chose between a convenient VTT training location and an inconvenient traditional training location. The majority of students in both groups indicated they would prefer a VTT course near their home port over a traditional course that was farther away from their home port. A Chi Square test showed that the differences in distribution of responses was not statistically significant for the two groups ($\chi^2(2) = 1.29, p > .05$).

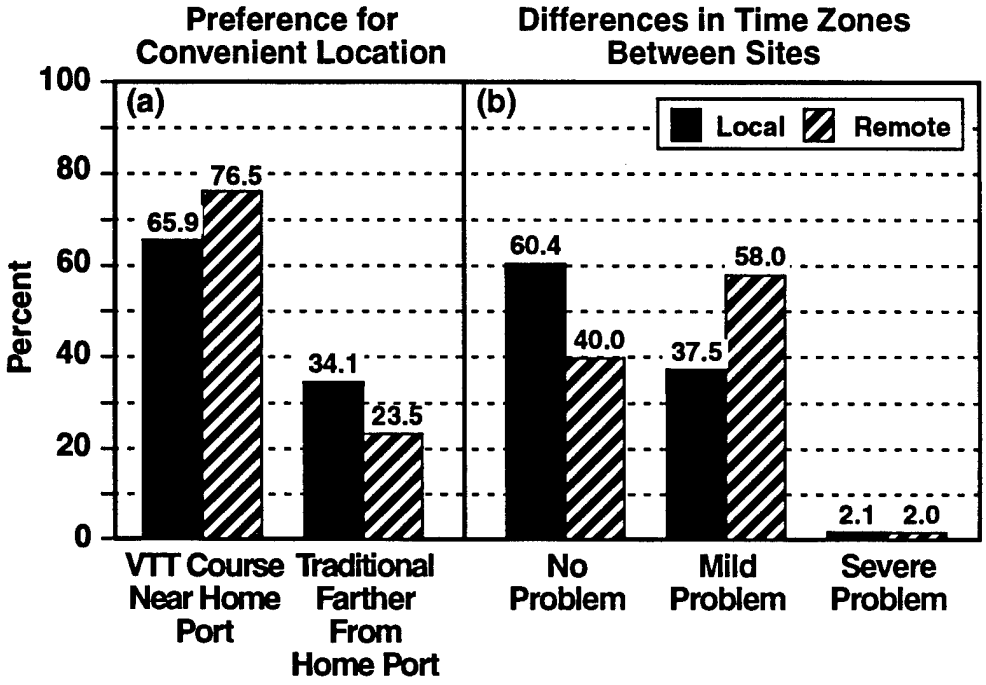

Figure 11. Student preference for convenient location and problems with differences in time zones (Items 40 and 41).

Student perceptions of problems resulting from the difference in time zones between the two sites is shown in Figure 11b (Item 41). The two sites differed by three hours during the study: remote students in Pearl Harbor started class early in the morning (6:30 AM) and local students in San Diego started class later in the morning (9:30 AM). Only one student in each student group responded that this caused a severe problem. Local and remote students differed in their tendency to report that there was no problem or a mild problem. The majority of local students indicated that there was no problem, whereas the majority of remote student indicated a mild problem. Thus, students who started class early in the morning were more likely to indicate a mild problem. To compute the Chi Square statistic, the two data points indicating severe problems were collapsed into the mild problems category. The Chi Square computed on the resulting two by two contingency table showed that there was a significant difference between local and remote student responses ($\chi^2(1) = 4.08, p < .05$).

Open-ended Questions

Questions 44 through 47 asked students to explain what they liked most and least about the course, problems encountered during laboratories, and to offer suggestions to improve the course. The written responses to each open-ended question were clustered into categories that are given in Appendix F. Two types of percentages were calculated: the percentage of students responding (Table F-3) and the percentage of comments by category within each treatment group (Tables F-4 to F-9). The pattern of responses on these open-ended items was generally similar for the two treatment groups.

Student comments on what they liked most about the course most frequently cited the hands-on computer training or learning about quality assurance (Item 44). These two categories comprised 45 percent of local and 33 percent of remote student comments. Positive aspects of receiving training by VTT were the next most frequent category of comments (26% local and 23% remote).

Student comments on what they liked least about the course were distributed over several categories without a predominant theme (Item 45). Complaints about course materials were more common in the comments of local (18%) than remote (3.8%) students. There were relatively few responses and small differences between the groups on the remaining topics that addressed issues with the computer program, assistance, VTT, and facilities. Only students at the remote site complained that the class started too early in the day (9.4% of comments).

Item 46 asked students to discuss problems encountered during the laboratories. Comments were provided by about a half of the remote students and by about a quarter of the local students. This difference in group response rates was approximately at the level of significance ($\chi^2(1) = 3.72$, $p \approx .05$). In responding to this item, 23.6 percent of the comments by remote students and 2.1 percent of the comments by local students concerned problems with using the CWP computer program. This result closely parallels that observed in the remarks section of the computer quiz discussed earlier. Of several other miscellaneous responses to this question, the only other prominent category concerned a need for more instruction and more time on the computers or laboratory paper work (10.4% local; 1.8% remote).

Slightly more than a third of local and remote students provided suggestions for improving the course (Item 47). These comments tended to parallel those on what was liked least about the course and in most cases there were not large differences between the two groups. About a quarter of local student comments concerned improving the content or delivery of the course, whereas only a tenth of remote student comments addressed this issue. About 15 percent of the comments by remote students (and none by local students) addressed improvements to the CWP computer program.

Interaction Tally

Instructor and student interactions that took place over the VTT network were recorded by an observer. Interactions for local and remote groups were analyzed by the type of class activity and the type of interaction. Data were transformed into a rate measure to adjust for differences in the recording periods for these activities and the slightly different number of students in local and remote classrooms (computations and data summaries are in Appendix C). This rate measure was

the number of interactions per student per hour and it was computed to reflect the level that would be observed in one average class convening (per class basis).

Interactions were recorded during three types of class activities: (1) lectures on the first two days of class; (2) student laboratories using paper-based materials (all on the second day of class except for a half an hour laboratory period that was also included from the first day); and (3) the student laboratory using computers on the third day of class (only remote students were present to use the VTT network because local students used a computer laboratory in another building).

Local and remote treatment groups were compared in terms of interactions that were initiated by either the instructor or students. Figure 12 shows three types of interactions that result from combining several tally categories described in Appendix C. Panel (a) shows instructor questions that identified a recipient that should respond to the question. These questions named a site or individual student (tally categories 2 and 3). Panel (b) shows instructor questions that did not identify a recipient. These questions were left open for any site or student to answer (tally category 1). Panel (c) shows student initiated questions and comments (tally categories 4 and 5). Thus, the two instructor categories differed in whether or not a recipient to answer the question was specified in the question (an answer was received from a student in both cases). Student questions and the instructor questions that did not specify a recipient shared a similarity in that both relied on the initiative of the student.

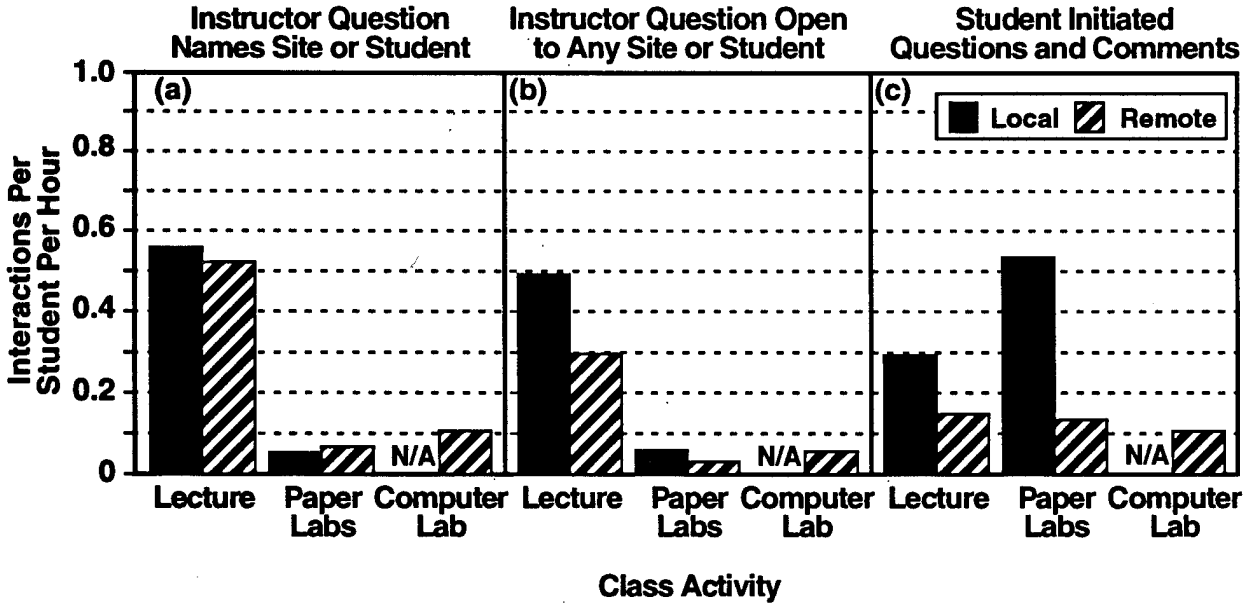

Figure 12. VTT interaction tally results for instructor and student initiated questions during three class activities.

A similar pattern is shown for both types of instructor questions in comparing the classroom activities (panel a and b). Instructor questions are much more frequent during lectures than during student laboratories. The higher level during lectures reflects the instructor-led nature of this

activity, whereas the instructor asks few questions when students are engaged in laboratory activities as they work individually or in small groups.

Instructor questions are also more frequent than student questions during lectures when the two types of instructor questions are added together. Combining local and remote groups, there were 1.85 interactions per hour per student for instructor questions and 0.42 for student questions (for all students in a class, these correspond to 23.26 and 5.41 interactions per hour).

During student laboratories, the relative level of interaction is slightly higher for student initiated questions than for instructor questions. This is particularly true for local students in the paper laboratories.

Statistical significance testing for this interaction rate data is made difficult because there are only four classes to use as observations. However, the raw frequencies combined over the four class convenings can be compared for certain aspects of the data. A Chi Square test was used to compare the observed interaction frequencies with expected frequencies that were derived by adjusting the observed frequencies using the proportion of students in the local and remote groups. These group comparisons were computed for each of the three types of questions for the lecture and paper laboratories (where recording time was equal between groups).

There are three instances in Figure 12 where there is a significantly lower level of interaction for remote than local students. For instructor questions that were directed to either a site or a specific student (panel a), there were no significant differences between local and remote students during lectures ($\chi^2(1) = 0.20, p > .05$) or paper laboratories ($\chi^2(1) = 0.54, p > .05$). For instructor questions that were open to any site or student to answer (panel b), remote students responded significantly less often than local students during lectures ($\chi^2(1) = 11.15, p < .01$), but not during paper laboratories ($\chi^2(1) = 1.16, p > .05$). For student initiated questions (panel c), there were significantly fewer questions initiated by remote than local students during both lectures ($\chi^2(1) = 10.3, p < .01$) and paper laboratories ($\chi^2(1) = 30.09, p < .01$).

These results indicate that the instructor distributed questions equally among students at the local and remote sites. However, remote students responded somewhat less frequently than local students in both circumstances where students initiated an interaction--either when initiating a question or when responding to an instructor question that was left open to answer by any site or student. Although remote students were less likely to initiate interactions, their participation was not less when the instructor identified them in questions. Thus, instructor-initiated behavior was important in maintaining remote student participation.

Other aspects of the interaction data summarized in Appendix C were examined without revealing interesting effects. Several effects observed in a previous study of a Celestial Navigation course (Wetzel, 1995) were only slight trends in the present study. This may reflect the relatively brief duration of the QA course. There were only slight increases in instructor and remote site student questions over the first two days of the lecture periods. Unanswered instructor questions were at a low level, changed little over the two days, and were only marginally higher for remote than local students. There was a generally low level of instructor reminders to local students to use their microphones and these declined slightly from the first to second day of class.

Cost Analysis

The costs involved in offering the QA course by VTT will be considered because there are additional costs beyond those found for the typical lecture course. Cost saving from the use of VTT are realized when student travel costs are avoided because students do not travel and instead receive training by VTT near their duty station. The overall costs for maintaining a VTT system are offset to the extent that the VTT system is used intensely. Increased usage results from fully scheduling VTT classrooms, courses with many students, and short duration courses permitting more classroom usage. Laboratory courses with few students are a concern from the perspective of offsetting VTT system costs with sufficient usage. The need to duplicate laboratory equipment at remote sites is also a concern if the equipment is expensive or if the number of students is constrained by access to a limited amount of training equipment.

A successful use of VTT would be indicated if the avoided costs for student travel exceeded the costs for using the VTT system. The analysis used to judge the success of the CESN system involves a comparison of the contract costs for maintaining the VTT system with avoided student travel costs that result because training is not available at remote sites and students must travel.[1] A similar analysis can be applied on a smaller scale to the QA course. This comparison of VTT contract costs and avoided student travel costs is described below on the basis of cumulative class convening costs during a year. Because computers were required to enable a VTT version of the course to be delivered to remote sites, computer costs are combined with the contract costs for VTT classrooms in the analysis.

Cost Elements and Method

The cost elements considered for the analysis of the QA course are avoided student travel costs, the contract costs for using the CESN VTT system, and the initial costs for computer equipment required to establish a remote site laboratory. Several parameters were selected to illustrate different scenarios: the amount of travel avoidance for sites of different distances from the San Diego training site, whether or not the cost of the computers is added to the contract costs for using VTT, and the number of computers, students, and class convenings. The computers represent an initial fixed cost that would be incurred in other courses where other types of equipment might need to be duplicated at remote sites to enable the course to be delivered. Hence, the form of this analysis could be followed for other courses. Details of the cost elements described below are given in Appendix E.

One cost scenario to be examined is the anticipated future use of the computer equipment supplied as part of this research. Four QA class convenings per year are projected to be delivered by VTT. It is planned that the equipment resulting from this research will be split between Pearl Harbor and Bangor, Washington, with five student computers at each site. Additionally, because

---

[1]CESN cost estimates from March 1989 to September 1995 indicate a total contract cost of $5,164,456 and total avoided costs of $9,174,332 ($7,108,424 training costs and $2,065,908 conference costs). Thus, contract costs are about 56 percent of the estimated avoided costs, which leads to the statement that system operation starts to break even about midway through a year. Excluding the ancillary use of the system for conferences, the contract costs are about 73 percent of the estimated avoided training costs. The average number of students per classroom is about 10 or 11. An early cost analysis of the CESN is given in Stoloff (1991).

the two hour laboratory is brief, the possibility of double-shifting the laboratory has been considered so that more students can use the existing computers. For example, some students could use the computers while others took the final examination and then these two sets of students could switch to the other activity. Double-shifting is a special circumstance that pertains to this course and it may not be possible in courses with a longer computer laboratory. Another cost scenario to examine is the effect of increased numbers of class convenings on the relative amount of travel avoidance. More convenings could represent greater usage of the computers that are shared with other courses. Another scenario is to vary the number of computers used in the training, which affects the ratio of students per computer.

VTT Costs. The average contract cost per room over all CESN VTT classrooms is approximately $70,000. Assuming 251 available training days per year, the per day cost of an average VTT classroom would be $279, and three days of use for this course would cost $837. The three day class convening costs would be $1,674 for two participating sites (one local and one remote classroom) and would be $2,511 for three participating sites (one local and two remote classrooms). These per convening costs are multiplied by the number of class convenings in the comparisons made below. These costs do not vary with the number of students present in a VTT classroom during a class convening. However, there is a relative benefit in travel avoidance to the extent that more remote site classrooms participate in the training. This is because the cost of additional VTT classrooms is accompanied by additional remote student travel avoidance and this reduces the relative impact of the cost of the local VTT classroom where no student travel avoidance is generated.

Computer Costs. Unlike lecture courses, establishing a remote site for the QA course required initial costs for the computer equipment that enabled the course to be delivered by VTT. The equipment used during the present study and the computer system costs used in this analysis are given in Tables E-1 through E-3 in Appendix E. The costs for computers were amortized over an expected lifetime that has been assumed to be five years.[2] Maintenance costs have been assumed to be 10 percent of the original cost of the computer equipment for each of the five years. The yearly cost of the computer system is the sum of the computer and maintenance costs for the five year period divided by the five years. This yearly cost of the computer system is then divided by the number of course convenings per year to adjust for the amount of usage of the computer system. This per convening cost of the computer system is reduced to the extent that there are more class convenings during a year (e.g., doubling the class convenings halves the per convening computer costs). This adjusted per convening cost of the computer system is then added to the per convening VTT classroom costs. The combined VTT and computer system cost is multiplied by the number of class convenings for comparison to the avoided student travel costs for a similar number of convenings (Table E-3 of Appendix E). This comparison is made below by subtracting the combined VTT and computer system costs from the avoided student travel costs (Tables E-5 and E-6).

---

[2]The costs for laptop computers are higher than for more conventional personal computers (PCs) and maintenance costs would likely be higher also. However, conventional PCs would require much more effort to move in and out of VTT classrooms. Alternatively, conventional PCs would require a dedicated installation in remote site classrooms that would likely reduce the number of student seats and would require an added furniture cost (e.g., glass-top desks that house the monitor below the surface).

The method described above was performed for four circumstances that represent the combinations of a small or large laboratory (5 or 10 computers) and one or two remote sites (a second remote site requires an additional printer and server computer). Instructor demonstration computer equipment at the local transmitting site is included in these costs, but no local-site computers are assumed because local students currently use an existing computer laboratory in San Diego. In the projected actual circumstance where the computers from this research have been split between two remote sites (Pearl Harbor and Bangor), the equipment cost is $42,034, total maintenance for 5 years at 10 percent a year is $21,017, and the sum of these two costs is $63,051. The $63,051 total is amortized to $12,610 per year when distributed over the assumed five year lifetime. Assuming the four projected convenings of this course per year, the per convening cost is then $3,153. Other numbers of convenings given below are computed similarly and more convenings per year results in a lower per convening cost because of the greater usage.

Avoided Travel Costs. Student travel costs were considered for several alternative West coast CESN sites for classes containing 10, 15, and 20 students. The avoided travel costs are for students who would have traveled or students who would have traveled had the travel funds been available (i.e., a VTT course offering becomes a training opportunity when made available at a remote site). The avoided student travel costs to San Diego from the three West Coast sites used in the analysis differ substantially. The total per student travel costs to San Diego were estimated to be $608 for Pearl Harbor, $346 for Bangor, Washington, and $204 for San Francisco (Treasure Island).[3]

The analysis assumed that two remote sites participated in the training during the same class convening (avoided travel costs for all individual sites and their combinations are given in Table E-4 of Appendix E). Two pairs of remote sites were selected for the analysis to illustrate different levels of travel avoidance. A high level of avoidance is represented with the actual projected remote sites for this course at Pearl Harbor and Bangor. For comparison, a less distant site was substituted to illustrate a lower level of avoidance by considering Bangor and San Francisco (Treasure Island) as remote sites. An equal number of students was assumed for each remote site. The avoided travel costs for one student per remote site for these comparisons was a sum of $954 for Pearl Harbor and Bangor, and was $550 for Bangor and San Francisco. In the analysis below, these combined costs were multiplied by the number of students per site and then by the number of class convenings (i.e., when computer and/or VTT costs are subtracted from avoided travel costs).

Cost Comparison

Table 1 shows avoided student travel costs in excess of the costs of delivering the course by VTT (i.e., either travel costs minus only VTT costs, or travel costs minus combined VTT and computer costs). The entries within a column are on a yearly basis as a function of the number of students and class convening during a year. Without the computer costs, the VTT costs are the same as would be incurred for a conventional lecture-based course, or if computer costs were not considered because they were already available at a remote site and did not have to be procured.

---

[3]These per student costs are the sum of airfare, local travel, and per diem costs. Government rate round-trip airfare to San Diego from Pearl Harbor, Bangor, and San Francisco was $480, $218, and $76 respectively. Local travel was estimated to be $20 and per diem was estimated to be $108 for four days (based on a $27 composite rate adjusted appropriate to 1 in 10 students being an officer at a slightly higher rate of $45 compared with $25 for the enlisted rate).

Table 1

Per Year Avoided Student Travel Costs in Excess of VTT Costs or in Excess of Combined VTT and Amortized Computer Costs

		Travel Minus VTT Costs		Travel Minus Combined VTT and Computer Costs			
		No Computers		5 Computers Each Remote Site (10 Total Computers)		10 Computers Each Remote Site (20 Total Computers)	
		(a) Sites	(b) Sites	(c) Sites	(d) Sites	(e) Sites	(f) Sites
Remote Students Each Site	Number of Class Convenings	PH BA SD	SF BA SD	PH BA SD	SF BA SD	PH BA SD	SF BA SD
				2 Students Per Computer		1 Student Per Computer	
10	4	28,116	11,956	15,504	-656	6,468	-9,692
10	8	56,232	23,912	43,624	11,304	34,584	2,264
10	12	84,348	35,868	71,736	23,256	62,700	14,220
				Double-shift Laboratory		Half Students 2 Per Computer	
15	4	47,196	22,956	34,584	10,344	25,548	1,308
15	8	94,392	45,912	81,784	33,304	72,744	24,264
15	12	141,588	68,868	128,976	56,256	119,940	47,220
				Double-shift Laboratory		All Students 2 Per Computer	
20	4	66,276	33,956	53,664	21,344	44,628	12,308
20	8	132,552	67,912	119,944	55,304	110,904	46,264
20	12	198,828	101,868	186,216	89,256	177,180	80,220

Note. Sites are the San Diego (SD) originating site and remote receiving sites at Pearl Harbor (PH), Treasure Island in San Francisco (SF), or Bangor, Washington (BA). Computer costs are amortized over 5 years and by convenings within years (including 10% maintenance per year). No student computers are assumed for San Diego because an existing computer laboratory is used. VTT classroom costs are for three classrooms, but avoided travel costs are for only two sites because local site students do not generate travel avoidance. The double-shift laboratory condition may apply only to this course because of the relatively brief laboratory. Additional convenings could represent more than one course sharing computers.

Travel Versus VTT Costs. Columns (a) and (b) of the table show avoided student travel costs in excess of the contract costs of the VTT classrooms with remote sites that differ in the level of avoided travel. Training is transmitted from San Diego (SD) to the Bangor (BA) site in both situations, but they differ in the magnitude of travel costs for the second remote site. There are higher travel costs for the more distant Pearl Harbor (PH) site (column (a)) than for the less distant San Francisco (SF) site (column (b)). The relative benefit shown in columns (a) and (b) indicates that there is more travel avoidance with the more distant pair of sites (column (a)) and with more students per class. Cumulative avoided costs increase with the number of class convenings during a year. These relationships are also shown in the other pairs of columns discussed below.

Travel Versus VTT and Computer Costs. The costs of five computers per site are included with the VTT classroom costs prior to subtracting them from the travel costs for the values shown in columns (c) and (d) of Table 1. Combining these computer costs with the VTT costs reduces the relative amount of student travel avoidance compared to when only the VTT costs are used (columns (a) and (b)). With four convenings, 10 students generate sufficient travel avoidance to exceed the VTT and computer costs for the more distant sites (column (c)). However, avoided travel costs for the less distant sites fall a little short (-$656) of exceeding the VTT and computer costs with 10 students (column (d)). To exceed the cost of computers and VTT for less distant sites, more students are required or more convenings are required when there are 10 students. When there are more convenings, there are more students and there is also some reduction in the impact of the cost of computers because the cost has been distributed over more usages.

With five computers per site, increasing the number of students increases the travel avoidance slightly while the costs for VTT and computers remain constant. However, there is an impact in the way the laboratory must be conducted when there are more students in a class. Increasing the number of students in a class requires that the laboratory be conducted in two shifts if a maximum of two students per computer is accepted as a reasonable upper limit.

Although four convenings are planned for this course, Table 1 additionally shows eight and twelve convenings. These additional convenings could represent an increased frequency of offering the QA course. Alternatively, the additional convenings could represent additional courses other than the QA course that also used the same computers (e.g., the QA course and one other course at eight convenings, and two other additional courses at 12 convenings). The greater usage provided by these additional convenings distributes the computer costs and lessens their per convening impact. This reduction allows the relative level of travel avoidance to be greater than the combined VTT and computer costs (e.g., as with the fewest students at the least distant sites in Table 1).

The projected distribution of the computer equipment used in this research among two remote sites can be compared with having left all the equipment at the original single site. The plan to use the current computer equipment to conduct four convenings of this course with Bangor and Pearl Harbor as remote sites provides a cost-beneficial situation. With 10 students, these sites generate avoided travel costs of $15,504 in excess of the combined costs for the VTT classrooms and computer equipment (column (c)). Had the original set of 10 student computers remained at the one Pearl Harbor site, the comparable cost for 10 students and four convenings would have been $6,212 (15 students would be $18,372 as per Table E-6 in Appendix E). Thus, for an equivalent number of students per site, there was an advantage to splitting the computers so that they could be used by two sites and more total students. As noted earlier, including additional remote sites

generates additional travel avoidance and reduces the relative impact of the VTT local-site classroom costs where no travel avoidance is generated.

Increasing Laboratory Size. Columns (e) and (f) of the table show the situation where the size of the remote site laboratory is increased with additional computers (10 computers per site, or 20 total). This size of laboratory accommodates one student per computer with 10 students, half the students sharing a computer with 15 students, and all students sharing a computer with 20 students. The travel avoidance is positive for the more distant sites in column (c). For the less distant sites in column (d), avoided student travel costs fail to exceed the VTT and computer costs (-$9,692) when there are 10 students. However, increasing the number of student to 15 at four convenings or increasing the number of convenings to eight with 10 students produces avoided travel costs sufficient to just exceed the VTT and computer costs. Increasing the number of students to 15 or 20 results in more students sharing the 10 computers at each site, but does not require double shifting the laboratory. Compared with a laboratory of five computers per site, there is less advantage for equal numbers of students and convenings. Increasing the number of computers to 10 requires greater usage in the number of students or convenings to support the costs for the laboratory.

Discussion

The QA course was successfully adapted for delivery by video-teletraining. The converted course is scheduled to be offered to remote sites from San Diego. The evaluation results and observations from conducting the course are summarized below.

Summary of Empirical Findings

Student performance as measured by the final examination was high for both the local and remote VTT students and was similar to that for students in traditional non-VTT classes. The percentage of students passing the course was also similar in the groups. VTT local and remote students demonstrated similar levels of knowledge on the fact quiz covering the operation of the CWP program. VTT remote students were able to complete their assignments in the computer laboratory. These performance results are similar to those of previous studies that have found the difference between remote and local site students to range from no difference to five percent (Simpson, et al., 1990, 1991a, 1991b, 1992, 1993; Wetzel, 1995; Wetzel, et al., 1996; and studies reviewed in Wetzel, et al., 1994, pp. 19-21).

Student questionnaire responses showed few differences between the local and remote students. Three topic areas did show significant differences between the groups. First, the visibility of the instructional materials and details of the training aids were rated about a half a rating point lower by remote students than local student on a five point scale. Second, access to or attention from the instructor was rated from about a third to a half of a rating point lower by remote students on a five point scale. Local students were most likely to cite the instructor as a frequent source of assistance, whereas remote students cited assistance from a combination of the instructor, VTT facilitator, and other students. Third, a group of items indicated somewhat greater problems for remote than for local students on aspects of the computer laboratory. These items pertained to the difficulty of conducting the computer laboratory, printing documents, and operating the computer

program. These items were from one half to three quarters of a rating unit lower for remote than local students on a four point scale. However, the average difficulty ratings were in a positive direction slightly above the portion of the scale indicating "few" problems.

Other questionnaire responses indicated that remote and local students were generally accepting of VTT as a method to deliver this course. A majority of students would accept VTT or traditional forms of instruction and most students would take another VTT course. About two thirds of the students indicated that VTT did not have an overall effect on problems encountered in the course. Remote students in Pearl Harbor indicated a mild problem with starting the class early in the morning that is probably typical of other courses at that site. The convenience of a nearby VTT course was preferred over traveling to a distant traditional course.

The tally of interactions over the VTT network showed that instructor initiated questions during lectures were many times greater than when students were engaged in performing laboratory activities. Remote students were somewhat less likely to initiate participation than were local students, either when asking a question or when responding to an instructor question that was left open for any site or student to answer. However, instructor questions that named a site or student in the question served a beneficial role in maintaining remote student participation. These instructor questions were distributed equally among local and remote students and both groups responded at similar levels.

The objective of this research was to enhance VTT system utilization by extending the use of VTT to a laboratory course. The results indicate that it was instructionally feasible to deliver the computer laboratory in this course by VTT. An analysis of the additional costs of outfitting remote classrooms with computers also indicated a net benefit for the anticipated use of the equipment resulting from this research. In this analysis, avoided student travel costs were compared with the combined costs for the computer equipment and VTT classrooms. Amortized computer system costs were combined with VTT classroom contract costs because the computers were required to enable delivery of the course at remote sites. The projected delivery sites at Pearl Harbor and Bangor have five computers per site that will allow two students per computer. These sites would generate a beneficial level of avoided student travel costs with the projected four class convenings a year and 10 students per site. This level of throughput for these two sites would produce an estimated $15,504 of avoided student travel costs in excess of the combined costs for the VTT classrooms and amortized computer costs. Additional class convenings for this course or other courses that shared using the same computers would lessen the impact of the costs for outfitting sites with computers.

Observations from Conducting the Course

Several observations on the delivery of this course are applicable to conducting other hands-on laboratory courses by VTT. These include a phased implementation to develop techniques adapted to training distant students and the use of portable equipment to accommodate existing facilities.

In traditional laboratories, students are physically present with an instructor who circulates among students, looks over their shoulders to observe progress, and provides assistance or instruction as needed. This learning environment may need to be conveyed in different ways to allow VTT remote students to accomplish their tasks without the physical presence of the

instructor. When remote students perform laboratory activities at a distance from the instructor they must use the audio-video capabilities of the VTT system to communicate with the instructor, rely on resources at their site, or rely on prior instruction to work more independently.

The conversion of the QA course was benefited by using a phased approach to tryout and refine the delivery of the course prior to delivering it to an actual remote site (cf. conversion methods in Simpson, 1993; Wetzel, 1996). Instructors first practiced using the VTT system and then used the computers in a simulated local-remote environment. Several dry-run courses were conducted with students in a simulated-remote VTT classroom adjacent to that of the instructor. This permitted instructors to practice using the VTT system and allowed the lectures and demonstrations to be refined as a result of the experience. For example, the ability to see inscriptions on a mechanical valve was discovered to be a problem in showing it over the VTT system. High quality photographs were developed that were subsequently preferred by students over using the actual valve. Unable to circulate among remote students, instructors also developed a strategy to increase student participation by requesting them to display their paperwork on the document camera where it could be inspected and discussed.

An instructor demonstration was developed to compensate for the absence of the instructor for remote students in the computer laboratory. The instructor demonstration was delivered prior to conducting the laboratory to better prepare remote students for performing the task more independently. The demonstration showed the sequence of operating the program and included helpful tips on critical aspects of the program that were typically problems during the laboratory. This enhanced preparation of the students was used to offset the absence of the instructor within the room who would normally have been available to provide assistance in face-to-face interactive exchanges.

The instructor demonstration of the computer program was accomplished by using a scan converter to directly send a video image of the screen over the VTT system. This avoided difficulties with positioning a camera to show the screen and reflections from lights within the room. The resolution provided by the scan converter was less than that of the computer display. However, the resolution was sufficient for providing a general orientation to the sequence of operating the program when accompanied by the instructor's narrative. Material with low legibility was described verbally and the instructor described steps to be shown prior to executing commands so that student attention could be focused on the change when it occurred. A similar orientation technique was required for high resolution static materials in a Celestial Navigation course (Wetzel, 1995). Nautical publications contained small print tables and critical text was enlarged and arrows pointed to these entries so that students could locate entries in their own publications.

The capability to show computer screens over the VTT system was also used during the student laboratory when the instructor answered student questions on operating the program. The instructor would locate the particular point in the program where the student was encountering difficulties and show that screen over the VTT system. Thus, the difficulty of an exclusively verbal exchange was reduced because both participants were viewing the same screen while discussing the options at that point in the program. Only a one-way view was available to show the instructor computer screen to remote students. Instructor-student interactions on resolving problems were relatively brief in this course, but verbal exchanges resulting from not being able to see student screens probably increased the time required to resolve student problems. To show remote-student

computer screens to the instructor, laptops would have to be carried to the document camera or a more elaborate configuration would be required (e.g., students could take their computer to a centrally located scan converter, wiring could be extended to student workstations, or a within room video network could be used). This would better allow the instructor to provide assistance to students, but a hard-wired configuration could create logistical wiring problems within a VTT classroom.

The use of existing VTT classrooms for a laboratory course requires training equipment that is portable or can be adapted to be portable. VTT classrooms must be used by other courses and this sharing means that the room cannot be dedicated to the materials or equipment for just one course. Portable roll-away training equipment has been used beneficially in other VTT courses for fiber optic cable systems and for demonstration training aids (Simpson, et al., 1992; Wetzel, et al., 1996). Laptop computers were used for the QA course because they were portable and could be taken in and out of the classrooms with little difficulty. Additionally, the clutter of wiring required to connect to a printer was avoided by using a wireless local area network (LAN). Some problems with printing documents in the computer laboratory were due to the positioning of the infrared LAN devices within the room. These devices bounce signals within the room and some absorbent materials on the walls and ceiling may attenuate communication with certain regions of the room. This problem was addressed by adjusting the position of the server or the student stations to maintain reliable communications with all stations.[4]

The portable laptop computer system approach could be used for other CESN computer laboratory courses if modifications to existing rooms cannot be accommodated. Were their sufficient demand for training using computers, permanent installations of more elaborate computer systems could be developed. It would be possible to free desktop space for other classes by using computer desks with monitors mounted within the desk that can be viewed through a glass viewport in the desk top. However, the size of these desks would reduce the number of student seats per room compared with the desks now used for lecture classes. A wired LAN could be installed within the room and a video network could be used to select a student computer screen to be sent out over the VTT system. A more ambitious computer laboratory configuration could also be developed. For example, a data network could be installed in parallel to the VTT system to allow local and remote site computers to be internetworked (e.g., data could be shared between sites, student work could be inspected remotely, or remotely operated programs could be displayed on higher resolution monitors than those used for the VTT system video).

Laboratory courses also place greater demands on remote sites and VTT facilitators (Wetzel, 1996; Wetzel, et al., 1996). VTT facilitators play both behavioral and logistical roles. The behavioral role is as an assistant and intermediary to the instructor. The facilitator serves as an agent of the instructor within the remote room and also acts on behalf of the students in redirecting their questions and problems to the instructor. The facilitator's logistical role in this course would require setting up the VTT classroom with the portable course equipment and then storing it away following a class. The facilitator also would be required to support the LAN and computer systems.

---

[4]An alternative laptop computer configuration could employ hard-wired PCMCIA local area network cards. This wiring could remain in place and the benefit of being able to remove the portable laptop computers when other courses used the classroom would still be realized.

The success of delivering the QA course was due in part to the various preparation efforts and to the fact that the laboratory was not excessively challenging. The course involved a mild form of a hands-on laboratory (Wetzel, 1996) in the sense that the computer laboratory is not long, the task is not difficult, and students could perform the task without extensive instructor assistance. Other kinds of computer skill-learning laboratories could involve more complex software and lengthy laboratories that would be more challenging than were those in the present course.

Recommendations

The following recommendations are for the Chief of Naval Education and Training and the CNET Electronic Schoolhouse Network.

1. Delivery of the Quality Assurance course by videoteletraining has been successful and the use of this method should be expanded to other sites as appropriate to satisfy demand for the course.

2. Portable laptop computers should be used if more permanent installations cannot be made within VTT classrooms for this and similar courses.

References

Bailey, S. S., Sheppe, M. L., Hodak, G. W., Kruger, R. L., & Smith, R. F. (1989, December). *Video teletraining and video teleconferencing: A review of the literature* (Technical Report 89-036). Orlando, FL: Naval Training Systems Center.

Barry, M., & Runyan, G. (1995). A review of distance-learning studies in the U.S. Military. *American Journal of Distance Education, 9*, 37-47.

Fleiss, J. L. (1981). *Statistical methods for rates and proportions.* New York, NY: John Wiley and Sons.

Rupinski, T. E. (1991). *Analyses of video teletraining utilization, effectiveness, and acceptance* (CRM Research Memorandum 91-159). Alexandria, VA: Center for Naval Analyses.

Rupinski, T. E., & Stoloff, P. H. (1990). *An evaluation of Navy video teletraining (VTT)* (CRM Research Memorandum 90-36). Alexandria, VA: Center for Naval Analyses.

Simpson, H. (1993). *Conversion of live instruction for videoteletraining: Training and classroom design considerations* (NPRDC-TN-93-04). San Diego, CA: Navy Personnel Research and Development Center. (AD-A261 051)

Simpson, H., Pugh, H. L., & Parchman, S. W. (1990). A two-point videoteletraining system: Design, development, and evaluation (NPRDC-TR-90-05). San Diego, CA: Navy Personnel Research and Development Center. (AD-A226 734)

Simpson, H., Pugh, H. L., & Parchman, S. W. (1991a). An experimental two-way video teletraining system: Design, development and evaluation. *Distance Education, 12*, 209-231.

Simpson, H., Pugh, H. L., & Parchman, S. W. (1991b). *Empirical comparison of alternative video teletraining technologies* (NPRDC-TR-92-3). San Diego, CA: Navy Personnel Research and Development Center. (AD-A242 200)

Simpson, H., Pugh, H. L., & Parchman, S. W. (1992). *The use of videoteletraining to deliver hands-on training: Concept test and evaluation* (NPRDC-TN-92-14). San Diego, CA: Navy Personnel Research and Development Center. (AD-A250 708)

Simpson, H., Pugh, H. L., & Parchman, S. W. (1993). Empirical comparison of alternative instructional TV technologies. *Distance Education, 14*, 147-164.

Simpson, H., Wetzel, C. D., & Pugh, H. L. (1995). *Delivery of division officer Navy leadership training by videoteletraining: Initial concept test and evaluation* (NPRDC-TR-95-7). San Diego, CA: Navy Personnel Research and Development Center. (AD-A298 102)

Stoloff, P. H. (1991). *Cost-effectiveness of U.S. Navy video teletraining system alternatives* (CRM Research Memorandum 91-165). Alexandria, VA: Center for Naval Analyses.

Wetzel, C. D. (1995). *Evaluation of a celestial navigation refresher course delivered by videoteletraining* (NPRDC-TR-96-2). San Diego, CA: Navy Personnel Research and Development Center. (AD-A300 925)

Wetzel, C. D. (1996). *Distributed Training Technology Project: Final Report* (NPRDC-TR-96-7). San Diego, CA: Navy Personnel Research and Development Center.

Wetzel, C. D., Radtke, P. H., & Stern, H. W. (1993). *Review of the effectiveness of video media in instruction* (NPRDC-TR-93-4). San Diego, CA: Navy Personnel Research and Development Center. (AD-A264 228)

Wetzel, C. D., Radtke, P. H., & Stern, H.W. (1994). *Instructional effectiveness of video media.* Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Wetzel, C. D., Radtke, P. H., Parchman, S. W., & Seymour, G. E. (1996). *Delivery of a fiber optic cable repair course by videoteletraining* (NPRDC-TR-96-4). San Diego, CA: Navy Personnel Research and Development Center. (AD-A304 318)

Wetzel, C. D., Simpson, H., & Seymour, G. E. (1995). *The use of videoteletraining to deliver chief and leading petty officer Navy leadership training: Evaluation and summary* (NPRDC-TR-95-8). San Diego, CA: Navy Personnel Research and Development Center. (AD-A298 374)

Wetzel, C. D., Van Kekerix, D. L., & Wulfeck, W. H. (1987a). *Characteristics of Navy training courses and potential for computer support* (NPRDC-TR-87-25). San Diego, CA: Navy Personnel Research and Development Center. (AD-A180 609)

Wetzel, C. D., Van Kekerix, D. L., & Wulfeck, W. H. (1987b). *Analysis of Navy technical school training objectives for microcomputer based training systems* (NPRDC-TR-88-3). San Diego, CA: Navy Personnel Research and Development Center. (AD-A187 666)

Appendix A

Computer Quiz

FORCES AFLOAT QA CWP GENERATOR QUESTIONNAIRE

1) How is the CWP generator accessed?

   A) C:\foxprow\cwpfox\cwpgen
   B) C:\win, cwp, cwp icon
   C) C:\cd cwpgen\ cwp
   D) None of the above

2) Why are files merged?

   A) Edit CWP
   B) Print QA form
   C) All of the above
   D) None of the above

3) How is a merged file saved?

   A) Cannot save a merged file
   B) Change file name in WordPerfect
   C) Automatically saved in CWP generator
   D) None of the above

4) What version of CWP generator is being utilized?

   A) Foxprow
   B) DOS
   C) Windows
   D) A and C

5) What version of WordPerfect is required in order to use the CWP generator.

   A) 5.1
   B) 6.0
   C) 5.1 or 6.0
   D) None

6) How are the merged files accessed in WordPerfect?

   A) Ctrl F
   B) Alt D
   C) Shift G
   D) None of the above

7) Changes made to the CWP are save in?

   A) CWP generator and WordPerfect
   B) WordPerfect
   C) CWP generator
   D) None of the above

8) IF the CWP program "locks-up" pressing Ctrl, Alt, Delete will free the program and allow the editing process to continue.

A) True B) False

9) Help can be called up at the beginning of the CWP program giving the user instructions on how to maneuver within the generator.

A) True B) False

10) Enter, Ctrl, F1, and Esc are the primary keys utilized when maneuvering within the CWP generator.

A) True B) False

Remarks:_____

Appendix B

Student Questionnaire

STUDENT QUESTIONNAIRE FOR QUALITY ASSURANCE (QA) COURSE

The purpose of this survey is to collect information that will help make a decision about the value of remote-site training by means of video teletraining (VTT). The information that you provide will NOT be used to evaluate you or your instructor. It will be used only for research purposes to evaluate VTT and will not be kept in your service records. Please answer the questions as honestly and completely as you can.

a. Name_____ _____ _____ _____
Last First MI Rate & Rank

b. Today's date_____ c. Location [ ] San Diego
[ ] Pearl Harbor
[ ] _____

For each of the statements followed by [1] [2] [3] [4] [5] , please circle the box indicating how well you agree with the statement using this scale:

[1] Strongly Disagree	[2] Disagree	[3] Neither Agree/ Disagree	[4] Agree	[5] Strongly Agree

---

INSTRUCTORS	Disagree SD	D	N	A	Agree SA
1. Instructors were prepared & presented lessons clearly	[1]	[2]	[3]	[4]	[5]
2. Instructors encouraged class participation	[1]	[2]	[3]	[4]	[5]
3. Instructors answered student questions adequately	[1]	[2]	[3]	[4]	[5]
4. Instructors helped students who needed assistance	[1]	[2]	[3]	[4]	[5]
5. Instructors maintained adequate control of class	[1]	[2]	[3]	[4]	[5]

LEARNING ACTIVITIES & TRAINING AIDS	Disagree SD	D	N	A	Agree SA
6. I could clearly see the instructional materials presented by the instructor	[1]	[2]	[3]	[4]	[5]
7. I could clearly hear the instruction	[1]	[2]	[3]	[4]	[5]
8. The course provided skills that can be applied on the job	[1]	[2]	[3]	[4]	[5]
9. I had access to the instructors outside of class concerning the course content	[1]	[2]	[3]	[4]	[5]
10. Instruction and demonstrations on completing the forms was adequate	[1]	[2]	[3]	[4]	[5]
11. Instruction and demonstration of computer procedures was adequate for the computer lab	[1]	[2]	[3]	[4]	[5]
12. Paper and pen exercises were completed without problems	[1]	[2]	[3]	[4]	[5]

	Disagree SD	D	N	A	Agree SA
13. The computer laboratory was accomplished without problems	[1]	[2]	[3]	[4]	[5]
14. Training aids were used effectively	[1]	[2]	[3]	[4]	[5]
15. Details of training aids could be clearly seen (for example, transparencies/graphics/forms)	[1]	[2]	[3]	[4]	[5]
16. Table space and room layout were adequate to accommodate the use of computers	[1]	[2]	[3]	[4]	[5]

INTERACTION/PARTICIPATION	Disagree SD	D	N	A	Agree SA
17. Interaction between instructors and students was adequate to support learning objectives	[1]	[2]	[3]	[4]	[5]
18. Student participation was sufficient to support learning objectives	[1]	[2]	[3]	[4]	[5]
19. Students aided one another in performing course exercises	[1]	[2]	[3]	[4]	[5]
20. Instructors gave equal attention to all students	[1]	[2]	[3]	[4]	[5]
21. I hesitated to ask questions in order to clarify procedures or concepts	[1]	[2]	[3]	[4]	[5]
22. The ability of students to get help was adequate	[1]	[2]	[3]	[4]	[5]
23. The course provided skills that can be applied on the job	[1]	[2]	[3]	[4]	[5]

EFFECTIVENESS OF SPECIFIC PORTIONS OF THE COURSE

24. The lectures were accomplished with:

[ ]-No problems [ ]-Few problems [ ]-Some problems [ ]-Many problems

25. The laboratory exercises with paperwork were accomplished with:

[ ]-No problems [ ]-Few problems [ ]-Some problems [ ]-Many problems

26. The computer laboratory was accomplished with:

[ ]-No problems [ ]-Few problems [ ]-Some problems [ ]-Many problems

27. Printing documents was accomplished with:

[ ]-No problems [ ]-Few problems [ ]-Some problems [ ]-Many problems

28. Operating the computer program was accomplished with:

[ ]-No problems [ ]-Few problems [ ]-Some problems [ ]-Many problems

29. When working with the computer program:
    [ ] I worked in a team and someone else operated the program
    [ ] I worked in a team and I operated the program myself
    [ ] I worked in a team and we switched off operating the program
    [ ] I worked alone and operated the program myself

BACKGROUND	Disagree SD [1]	D [2]	N [3]	A [4]	Agree SA [5]
30. Before this course, I had basic knowledge of Quality Assurance concepts and forms					

31. How would you rate your general skill or background in using computers:
    [ ] None/Beginner
    [ ] Novice
    [ ] Intermediate
    [ ] Accomplished
    [ ] Advanced

32. What is your level of typing or keyboarding skill?
    [ ] Hunt-and-Peck
    [ ] Beginner
    [ ] Intermediate
    [ ] Accomplished
    [ ] Advanced

VIDEO-TELETRAINING	Disagree SD [1]	D [2]	N [3]	A [4]	Agree SA [5]
33. Instructors coordinated activities among classroom sites effectively					
34. Local and remote site classrooms participated equally in the class					
35. Instructors called on students at all of the classroom sites about equally					
36. The VTT facilitators assisting the instructor were helpful to students in the remote class					

37. Who most frequently provided assistance to you:
    [ ] Instructor
    [ ] VTT Facilitator
    [ ] Other students
    [ ] No help needed
    [ ] Other (please explain): _____

38. Which method of instruction would you prefer for this course:
    [ ] Video Tele-Training (VTT)
    [ ] Traditional method (non-VTT)
    [ ] Either method

39. How did the VTT method of instruction affect your opportunities to interact with the instructor?
    [ ] more opportunities
    [ ] no effect on opportunities
    [ ] fewer opportunities

40. Which of the following would you prefer? (check one)
    [ ] Enrolling in a VTT course near your home port?
    [ ] Enrolling in a traditional (live) course farther (TAD) from your home port?

41. Differences in time zones between San Diego and the Remote site were:
    [ ] No problem
    [ ] Mild problem
    [ ] Severe problem

42. Compared to offering the course by a traditional method, offering this course by VTT results in:
    [ ] More problems than traditional method
    [ ] No effect on problems encountered
    [ ] Fewer Problems than traditional method

43. If you had a choice, would you take another VTT course?
    [ ] Yes
    [ ] No

Please explain:_____

_____

_____

---

44. What did you like the most about this course?_____

_____

_____

45. What did you like the least about this course?_____

_____

_____

46. Discuss problems encountered during the laboratories_____

_____

_____

47. Discuss any suggestions you have for improving the course_____

_____

_____

_____

Appendix C

Interaction Tally Categories and Summary Statistics

VTT Interaction Tally Categories

An observer recorded the frequency of interactions that occurred over the VTT network in several categories given below. Interactions had to be related to course content. Start and end times for each class period were recorded on the tally form in order to account for variations of these periods over different class convenings. For each of the first five categories below, a check mark was entered in a box corresponding to whether it occurred at the local site or the remote site.

Instructor questions (Categories 1-3):

(1) Instructor question open to any site: Instructor asks a question (and receives an answer) in which no site is identified so that all sites are free to respond to the question.

(2) Instructor question names a site: Instructor asks a question (and receives an answer) that identifies a site which should answer, either the local site, a specific remote site, or "any" remote site.

(3) Instructor questions specific student: Instructor asks a question (and receives an answer) directed at one student by singling out the student by name, title, or by pointing (a class roster for each site was created during the first morning of the class).

Student questions (Categories 4-5):

(4) Student initiated question: A student initiates a question to the instructor, class, or another student.

(5) Student conversations and exchanges: Student exchanges, comments, or general conversations involving continued back-and-forth exchanges on an issue, such as to resolve a problem. These were most commonly a continuation of a student initiated question that resulted in more than one communication each for the instructor and student, including another student than the one initiating the original question.

Unanswered questions and microphone reminders (Categories 6-8):

Several other miscellaneous circumstances were recorded separately in addition to the above categories. These were recorded for the whole class and not by remote and local sites, or only for local students in the case of category 8:

(6) No answer to question: There was No Answer from students to an instructor question which was specific to the instructional content.

(7) No answer to generic request for questions: The instructor asked in one way or another if there were "Any Questions" and no response was received from the students. These questions were generic queries that were used to pause before proceeding with the instruction.

(8) Reminders to local students to use microphones: The instructor reminded the local San Diego site to use the microphones so remote sites could hear questions and comments.

Table C-1
Symbols and Formulas Used in Interaction Rate Computations

I	=	Sum of number of interactions over four classes
H	=	Total recording hours over four classes
C	=	Number of classes
S	=	Total number of students over four classes
S/C	=	Students per class
H/C	=	Recording hours per class
I/H	=	Interactions per hour
(I/H)/(S/C)	=	Interactions per hour per student (per class)
(I/H)/(S/C)	=	(I/S)/(H/C) = [(I/C)/(H/C)]/(S/C)

Table C-2
Instructor and Student Interaction Frequencies for Class Activities

	Lectures		Paper Labs		Computer Lab	
Measure and Group	**Local**	**Remote**	**Local**	**Remote**	**Local**	**Remote**
Number of students (S)	48	53	48	52.5	-	38
Number of classes (C)	4	4	4	4	-	3
Students per class (S/C)	12	13.25	12	13.12	-	12.66
Total recording hours (H)	18.26	18.26	9.33	9.33	-	5.30
Recording hours per class (H/C)	4.56	4.56	2.33	2.33	-	1.76
Interaction Frequencies (I)						
Instructor Questions:						
(1) Open to any site	109	73	5	2	-	3
(2) Names a site	94	101	2	7	-	3
(3) Specific student	25	23	2	0	-	4
Student Questions:						
(4) Student initiated	32	18	46	12	-	7
(5) Conversations/exchanges	31	18	14	4	-	0
All instructor (1-3)	228	197	9	9	-	10
All student (4-5)	63	36	60	16	-	7
All instructor and student (1-5)	291	233	69	25	-	17

Note: Lectures and paper laboratories were during first two days of class. Computer laboratory was on third day of class (only remote students were in VTT classroom) and only three classes were observed due to equipment failure. Letters in parentheses denote measures given in Table C-1. Numbers in parentheses are interaction tally category numbers defined at start of appendix.

Table C-3
Instructor and Student Interaction Rates

Measure and Group	Lectures		Paper Labs		Computer Lab	
	Local	Remote	Local	Remote	Local	Remote
Interactions Per Hour (I/H)						
Instructor Questions:						
(1) Open to any site	5.96	3.99	0.53	0.21	-	0.56
(2) Names a site	5.14	5.52	0.21	0.75	-	0.56
(3) Specific student	1.36	1.25	0.21	0.00	-	0.75
Student Questions:						
(4) Student initiated	1.75	0.98	4.92	1.28	-	1.32
(5) Conversations/exchanges	1.69	0.98	1.50	0.42	-	0.00
All instructor (1-3)	12.48	10.78	0.96	0.96	-	1.88
All student (4-5)	3.44	1.97	6.42	1.71	-	1.32
All instructor and student (1-5)	15.93	12.75	7.39	2.67	-	3.20
Interactions Per Hour Per Student (I/H)/(S/C)						
Instructor Questions:						
(1) Open to any site	0.49	0.30	0.04	0.01	-	0.04
(2) Names a site	0.42	0.41	0.01	0.05	-	0.04
(3) Specific student	0.11	0.09	0.01	0.00	-	0.05
Student Questions:						
(4) Student initiated	0.14	0.07	0.41	0.09	-	0.10
(5) Conversations/exchanges	0.14	0.07	0.12	0.03	-	0.00
All instructor (1-3)	1.04	0.81	0.08	0.07	-	0.14
All student (4-5)	0.28	0.14	0.53	0.13	-	0.10
All instructor and student (1-5)	1.32	0.96	0.61	0.20	-	0.25

Note: Lectures and paper laboratories were during first two days of class. Computer laboratory was on third day of class (only remote students were in VTT classroom) and only 3 classes were observed due to equipment failure. All values in table are truncated from greater precision.

Table C-4
Interaction Frequencies and Rates for
Unanswered Questions and Microphone Reminders

Measure and Category	Lectures	Paper Labs	Computer Lab
Interaction Frequencies (I)			
(6) No answer to instructor question			
Open to any site	3	0	0
Names a site or student:			
Local	2	0	--
Remote	7	1	0
(7) No answer to "any questions" query	47	9	2
(8) Microphone reminders to local students	12	2	--
Interactions Per Hour (I/H)			
(6) No answer to instructor question			
Open to any site	0.164	0.000	0.000
Names a site or student:			
Local	0.109	0.000	----
Remote	0.383	0.107	0.000
(7) No answer to "any questions" query	2.572	0.964	0.377
(8) Microphone reminders to local students	0.656	0.214	----
Interactions Per Hour Per Student (I/H)/(S/C)			
(6) No answer to instructor question			
Open to any site	0.013	0.000	0.000
Names a site or student:			
Local	0.009	0.000	----
Remote	0.028	0.008	0.000
(7) No answer to "any questions" query	0.213	0.073	0.029
(8) Microphone reminders to local students	0.054	0.017	----

Note: Only remote students were present in the VTT classroom during the computer laboratory. Microphones reminders for category (8) are for local classroom only.

Table C-5
Interaction Frequencies and Rates for Lectures on First Two Days of Class

Measure and Category	Day 1	Day 2	Difference
Total Recording Hours (H) Per Day	11.116	7.150	
Interaction Frequencies (I)			
Instructor Questions (1-3)			
Local	121	107	
Remote	100	97	
Student Questions (4-5)			
Local	39	24	
Remote	19	17	
Unanswered instructor questions (6)	6	6	
No answer to "any questions" query (7)	23	24	
Microphone reminders to local students (8)	9	3	
Interactions Per Hour (I/H)			
Instructor Questions (1-3)			
Local	10.884	14.965	4.081
Remote	8.995	13.566	4.571
Student Questions (4-5)			
Local	3.508	3.356	-0.152
Remote	1.709	2.377	0.668
Unanswered instructor questions (6)	0.539	0.839	0.299
No answer to "any questions" query (7)	2.068	3.356	1.287
Microphone reminders to local students (8)	0.809	0.419	-0.390
Interactions Per Hour Per Student (I/H)/(S/C)			
Instructor Questions (1-3)			
Local	0.907	1.247	0.340
Remote	0.678	1.023	0.345
Student Questions (4-5)			
Local	0.293	0.279	-0.014
Remote	0.128	0.179	0.051
Unanswered instructor questions (6)	0.021	0.033	0.012
No answer to "any questions" query (7)	0.081	0.132	0.050
Microphone reminders to local students (8)	0.067	0.034	-0.033

Note: Interaction rates adjust for unequal recording periods that are reflected in interaction frequencies. Only the lecture class activity is compared over days. Recording time was too brief to compare paper laboratories because only a half an hour period was given on the first day (total hours for the four classes were 1.92 on day 1 and 7.42 on day 2).

Table C-6
Correlation Between Observer Interaction Tallies

Interaction Category	Number of Observation Pairs	Correlation Simulated Remote Classes	Correlation Actual Remote Classes
(1) Instructor Question Open to Any Site	8	0.876	0.952
(2) Instructor Question Names a Site	8	0.520	0.835
(3) Instructor Questions Specific Student	8	0.484	0.769
(4) Student Initiated Questions	8	0.489	0.648
(5) Student Conversations and Exchanges	8	0.663	0.557
All 5 Categories Combined:			
Local Site Only	20	0.868	0.930
Remote Site Only	20	0.889	0.906
Local and Remote Combined	40	0.870	0.917

Explanation of Table C-6: Rater agreement using the interaction tally was determined during lectures on the first and second day of class. Data were obtained from two dry-run class convenings when the remote classroom condition was simulated in San Diego and during two class convenings with actual remote students in Pearl Harbor. Pearson correlation coefficients were calculated for two raters observing the same sessions in which there was one local and one remote site (perfect correspondence between raters would be indicated by a coefficient of +1.0). The overall 0.87 (simulated remote) or 0.917 (actual remote) correlation between rater interaction frequencies was based on an overall total of 40 pairs of observations where each rater made observations for five tally categories (1-5) by two sites (local and remote) by two recording periods (first and second day of class) by two separate class convenings. The two correlations for only local or remote sites were each based on 20 observations (i.e., two recording periods by two class convenings by five tally categories). The five correlations for the individual categories were based on eight observations in each category (i.e., two sites by two recording periods by two class convenings for each rater). The total interactions recorded during the two simulated remote class convenings was 239 for one rater and 223 for the other rater; during the two actual remote class convenings these sums were 262 and 274. Only one rater observed all four of the actual remote site classes to Pearl Harbor and only that rater's data was used in the analyses given in previous tables.

The interpretation of one series of interactions posed a scoring difficulty for raters. The instructor required successive individual students to read one statement from a list of statements in a student manual. An individual student was to read one statement and then the next student was to read the next statement in the series. This sequence sometimes alternated between sites or among students at one site. In the midst of this series, an interaction became an implicit question because each student was not verbally designated to read a statement. A discrepancy between rater interpretations of this situation was resolved by defining these circumstances to be questions that implicitly named a specific student (category 3) rather than ones that named a site (category 2). The table shows that the correlation between raters improved in the two later classes (actual remote) as a consequence of resolving this discrepancy.

Appendix D

Student Summary Statistics

Table D-1

Number and Percent of Enlisted and Officer Students by Treatment Group

Treatment Group	Officer and Enlisted Student Subgroups		
	Officer	Enlisted	All Students
VTT Local	5 (10.42%)	43 (89.58%)	48 (100%)
VTT Remote	4 (7.69%)	48 (92.31%)	52 (100%)
Traditional	17 (12.78%)	116 (87.21%)	133 (100%)
Combined Groups	26 (11.16%)	207 (88.84%)	233 (100%)

Note: Percentages are within rows of total students per treatment group. The proportion of officer and enlisted students by treatment group did not differ significantly by a test of proportions expressed as Chi Square, $\chi^2(2)=1.01$, $p>.05$ (Fleiss, 1981, p.139).

Table D-2

Average Military Rank for Enlisted and Officer Students by Treatment Group

Group	Mean Military Rank	Standard Deviation	Range (Min-Max)	Number of Students
Officer:				
VTT Local	1.60	0.89	1-3	5
VTT Remote	1.25	0.50	1-2	4
Traditional	2.00	1.17	1-4	17
All Officer Groups	1.81	1.05	1-4	26
Enlisted:				
VTT Local	5.48	1.54	1-8	43
VTT Remote	5.77	1.01	4-9	48
Traditional	6.12	1.09	4-9	116
All Enlisted Groups	5.91	1.21	1-9	207

Note: Min-Max for range is the minimum and maximum military rank.

Table D-3

Average Examination Percent Correct by Treatment group for Officer and Enlisted Students

Group	Mean Exam Percent	Standard Deviation	Range (Min-Max)	Number of Students
Officer:				
VTT Local	97.20	2.28	94-100	5
VTT Remote	94.00	4.89	88-100	4
Traditional	95.64	4.70	82-100	17
All Officer	95.69	4.33	82-100	26
Enlisted:				
VTT Local	93.41	4.77	80-100	43
VTT Remote	91.75	6.69	74-100	48
Traditional	93.61	6.78	56-100	116
All Enlisted	93.14	6.41	56-100	207
Combined Officer-Enlisted:				
All Local	93.81	4.71	80-100	48
All Remote	91.92	6.56	74-100	52
All Traditional	93.87	6.57	56-100	133
All Groups	93.42	6.26	56-100	233
Adjusted Means:				
All Local	94.13			
All Remote	92.14			
All Traditional	93.66			

Note: Min-Max for range is the minimum and maximum examination percentage correct. The correlation of final grade percent correct with z-score military rank for all three treatment groups combined was r=0.1495 (df=231, p=0.02). The correlation of officer-enlisted status with final grade percent correct for all three treatment groups combined was r=0.1285 (df=231, p=0.0501). The adjusted means shown in the table are based on an analysis of covariance (ANCOVA) using the z-score military rank and officer-enlisted status as covariates. The combination of these covariates was significantly related to examination performance, $F(2,228)=4.22$, $p=.015$. However, adjusting the small differences between treatment groups for these covariates does not change the finding that the treatment groups did not differ significantly, ANCOVA $F(2,228)=1.55$, $p>.05$.

Table D-4

Percentage of Students Passing Course

Group	Number of Students	Number Failing	Number Passing	Percent Passing
VTT Local	48	0	48	100.0 %
VTT Remote	52	1	51	98.1 %
Traditional	133	5	128	96.2 %
Combined Groups	233	6	227	97.4 %

Note: Passing for the final examination was 80% and above. The proportion of students passing in the three treatment groups was not significantly different, $\chi^2(2)=2.09$, $p>.05$ (Fleiss, 1981, p.139).

Table D-5

Average Percent Correct on Computer Quiz

Group	Mean Percent Correct	Standard Deviation	Range (Min-Max)	Number of Students
VTT Local	46.53	18.55	0-90	49
VTT Remote	45.75	16.39	0-80	47
Combined Groups	46.15	17.43	0-90	96

Note: Min-Max for range is the minimum and maximum quiz percentage correct. Percent correct is based on 10 possible correct items for quiz shown in Appendix A.

Appendix E

Computer Equipment and Cost Analysis Tables

Table E-1
Computer System Equipment Used in Evaluation Study

Local Transmitting Site	
Instructor Demonstration Laptop Computer:	
IBM 360 Laptop Computer (486SX/33Mhz; 4Mb RAM; 170Mb Harddrive)	$2,100
4 Mb RAM upgrade to total of 8Mb	$210
Included Software: PCDOS V6.3; Windows for Workgroups V3.11	$0
Total:	$2,310
Scan Converter (Computer VGA to NTSC video):	$1,600
Remote Site	
Student Laptop Computer:	
IBM 360 Laptop Computer (486SX/33Mhz; 4Mb RAM; 170Mb Harddrive)	$2,100
4 Mb RAM upgrade to total of 8Mb	$210
Photonix PCMCIA Infrared Local Area Network (LAN) Adapter	$450
Included Software: PCDOS V6.3; Windows for Workgroups V3.11	$0
IBM TCP/IP for DOS/Windows V2.1.1 Software	$159
IBM TCP/IP NFS Kit for DOS/Windows V2.1.1 Software	$94
Total One System (10 systems were used in the research):	$3,013
Print Server Computer:	
IBM Compatible PC Computer (486/66Mhz; 16Mb RAM; 420Mb Hardrive)	$1,350
CDROM Drive	$150
IBM Infrared Local Area Network (LAN) Adapter	$400
Computer Monitor	$300
OS2 WARP multitasking operating software	$115
IBM TCP/IP for OS2 V2.0 Software	$139
IBM TCP/IP NSF Kit for OS2 Software	$106
IBM TCP/IP DOS/Windows Access Kit for OS2 V2.0 Software	$62
Total:	$2,622
Server Hewlett-Packard LaserJet 4+ Printer:	$1,375
Miscellaneous:	
Flat Cord Guard Power Strips	$250
Portable cart with lockable doors for storing computers	$500

Note: There is no implied endorsement for any of the commercial products mentioned in this report. In most cases there are alternative products that could have been employed and mention of these products simply documents the actual equipment used in the research. Product names and brands mentioned herein are trademarks of their respective holders.

Table E-2
Estimates for Computer System Equipment Used in Cost Analysis

Local Transmitting Site:	1 Instructor Demonstration Laptop Computer	$2,310
	1 Scan Converter	$1,600
	Total	$3,910
5 Computer Remote Site:	5 Student Laptop Computers (@ $3,013 each)	$15,065
	1 Print Server Computer	$2,622
	1 Laser Printer	$1,375
	Total	$19,062
10 Computer Remote Site:	10 Student Laptop Computers (@ $3,013 each)	$30,130
	1 Print Server Computer	$2,622
	1 Laser Printer	$1,375
	Total	$34,127

	1 Remote + 1 Local		2 Remotes + 1 Local	
Steps of Computation	5 Computers	10 Computers	5 Computers	10 Computers
Local Site	$3,910	$3,910	$3,910	$3,910
1st Remote Site	$19,062	$34,127	$19,062	$34,127
2nd Remote Site	---	---	$19,062	$34,127
Total Equipment	$22,972	$38,037	$42,034	$72,164
Maintenance for 5 years (10% Equipment per year)	$11,486	$19,019	$21,017	$36,082
Total Equipment + Maintenance	$34,458	$57,056	$63,051	$108,246
Yearly Cost of Computer System (Amortized Over 5 Year Period) (Total / 5 years)	$6,892	$11,411	$12,610	$21,649
Cost Per Class Convening Amortized Within a Year (Yearly Cost / Number Convenings)				
1 Convening	$6,892	$11,411	$12,610	$21,649
4 Convenings	$1,723	$2,853	$3,153	$5,412
8 Convenings	$ 862	$1,426	$1,576	$2,706
12 Convenings	$ 574	$ 951	$1,051	$1,804

Table E-3
VTT Classroom Costs and Computer System Costs

VTT Classroom Costs:

VTT Classroom Contract Cost (1 room per year)*	$70,000
Available Training Days a Year	251
VTT Classroom Cost Per Day (1 classroom)	$279
VTT Classroom Cost Per Class Convening (3 days, 1 classroom)	$837
One Class Convening Cost (3 days, 2 or 3 classrooms):	
2 Classrooms (1 local, 1 remote)	$1,674
3 Classrooms (1 local, 2 remote)	$2,511

Combined Yearly Cost of VTT Classrooms and Computer Equipment For Different Numbers of Class Convenings Per Year:**

2 VTT Classrooms (1 Remote + 1 Local)

5 Computers at 1 Remote Site:

4 Convenings x	($1,674 VTT + $1,723 Computer)	=	$13,588
8 Convenings x	($1,674 VTT + $862 Computer)	=	$20,288
12 Convenings x	($1,674 VTT + $574 Computer)	=	$26,976

10 Computers at 1 Remote Site:

4 Convenings x	($1,674 VTT + $2,853 Computer)	=	$18,108
8 Convenings x	($1,674 VTT + $1,426 Computer)	=	$24,800
12 Convenings x	($1,674 VTT + $951 Computer)	=	$31,500

3 VTT Classrooms (2 Remotes + 1 Local)

5 Computers per Each of 2 Remote Sites:

4 Convenings x	($2,511 VTT + $3,153 Computer)	=	$22,656
8 Convenings x	($2,511 VTT + $1,576 Computer)	=	$32,696
12 Convenings x	($2,511 VTT + $1,051 Computer)	=	$42,744

10 Computers per Each of 2 Remote Sites:

4 Convenings x	($2,511 VTT + $5,412 Computer)	=	$31,692
8 Convenings x	($2,511 VTT + $2,706 Computer)	=	$41,736
12 Convenings x	($2,511 VTT + $1,804 Computer)	=	$51,780

*Note: VTT classroom contract costs based on average of all CESN classrooms.

**Note: Amortized computer equipment costs per convening from bottom of Table E-2.

Table E-4
Avoided Student Travel Costs for One Class Convening

	Per Student Avoided Travel Costs by Participating Sites					
	1 Remote + 1 Local Site			2 Remote + 1 Local Sites		
Individual Site	PH-SD	BA-SD	SF-SD	PH-BA-SD	PH-SF-SD	BA-SF-SD
Pearl Harbor (PH)	608	-	-	608	608	-
Bangor WA (BG)	-	346	-	346	-	346
San Francisco (SF)	-	-	204	-	204	204
San Diego (SD)	0	0	0	0	0	0
Total All Sites: (1 student each site)	$608	$346	$204	$954	$812	$550

Number Students	Total Avoided Costs for All Remote Sites (Equal Students Per Site)					
Each Remote Site	PH-SD	BA-SD	SF-SD	PH-BA-SD	PH-SF-SD	BA-SF-SD
1	608	346	204	954	812	550
2	1,216	692	408	1,908	1,624	1,100
3	1,824	1,038	612	2,862	2,436	1,650
4	2,432	1,384	816	3,816	3,248	2,200
5	3,040	1,730	1,020	4,770	4,060	2,750
6	3,648	2,076	1,224	5,724	4,872	3,300
7	4,256	2,422	1,428	6,678	5,684	3,850
8	4,864	2,768	1,632	7,632	6,496	4,400
9	5,472	3,114	1,836	8,586	7,308	4,950
10	6,080	3,460	2,040	9,540	8,120	5,500
11	6,688	3,806	2,244	10,494	8,932	6,050
12	7,296	4,152	2,448	11,448	9,744	6,600
13	7,904	4,498	2,652	12,402	10,556	7,150
14	8,512	4,844	2,856	13,356	11,368	7,700
15	9,120	5,190	3,060	14,310	12,180	8,250
16	9,728	5,536	3,264	15,264	12,992	8,800
17	10,336	5,882	3,468	16,218	13,804	9,350
18	10,944	6,228	3,672	17,172	14,616	9,900
19	11,552	6,574	3,876	18,126	15,428	10,450
20	12,160	6,920	4,080	19,080	16,240	11,000

Note: Entries in the table assume an equal number of students at all remote sites for the three day course. These per student costs are based on the sum of airfare, local travel, and per diem costs. Government rate round-trip airfare to San Diego from Pearl Harbor, Bangor, and San Francisco was $480, $218, and $76 respectively. Local travel was estimated to be $20. Per diem for three training days and one travel day was $108 (based on a $27 composite rate adjusted appropriate to 1 in 10 students being an officer at a slightly higher rate of $45 compared with $25 for the enlisted rate).

Table E-5

Avoided Student Travel Costs in Excess of VTT Classroom Costs

Students Per Remote Site	No. Class Convenings	Participating Sites: 1 Remote + 1 Local PH-SD	1 Remote + 1 Local BA-SD	1 Remote + 1 Local SF-SD	2 Remotes + 1 Local PH-BA-SD	2 Remotes + 1 Local PH-SF-SD	2 Remotes + 1 Local BA-SF-SD
10	4	17,624	7,144	1,464	28,116	22,436	11,956
	8	35,248	14,288	2,928	56,232	44,872	23,912
	12	52,872	21,432	4,392	84,348	67,308	35,868
15	4	29,784	14,064	5,544	47,196	38,676	22,956
	8	59,568	28,128	11,088	94,392	77,352	45,912
	12	89,352	42,192	16,632	141,588	116,028	68,868
20	4	41,944	20,984	9,624	66,276	54,916	33,956
	8	83,888	41,968	19,248	132,552	109,832	67,912
	12	125,832	62,952	28,872	198,828	164,748	101,868

Note: Table entries are avoided student travel costs minus VTT classroom costs. Avoided student travel costs are from Table E-4 and are multiplied by the number of convenings. VTT classroom costs from top of Table E-3 are for two rooms ($1,674) or three rooms ($2,511) and are multiplied by the number of class convenings. Abbreviations for sites participating in a class are: San Diego (SD) hub site originating instruction and remote sites at Pearl Harbor (PH), Treasure Island, San Francisco (SF), and Bangor, Washington (BA). Only remote students generate cost avoidance, but costs for a VTT classroom at the transmitting hub site at San Diego are included with costs for remote site classrooms.

Table E-6

Avoided Student Travel Costs in Excess of Combined Costs for VTT Classrooms and Computer Equipment (5 or 10 per site)

Students Per Remote Site	No. Class Convenings	Participating Sites and Computers Per Site					
		1 Remote + 1 Local			2 Remotes + 1 Local		
		5 computers at 1 remote			10 computers (5 each remote)		
		PH-SD	BA-SD	SF-SD	PH-BA-SD	PH-SF-SD	BA-SF-SD
10	4	10,732	252	-5,428	15,504	9,824	-656
	8	28,352	7,392	-3,968	43,624	32,264	11,304
	12	45,984	14,544	-2,496	71,736	54,696	23,256
15	4	22,892	7,172	-1,348	34,584	26,064	10,344
	8	52,672	21,232	4,192	81,784	64,744	33,304
	12	82,464	35,304	9,744	128,976	103,416	56,256
20	4	35,052	14,092	2,732	53,664	42,304	21,344
	8	76,992	35,072	12,352	119,944	97,224	55,304
	12	118,944	56,064	21,984	186,216	152,136	89,256
		1 Remote + 1 Local			2 Remotes + 1 Local		
		10 computers at 1 remote			20 computers (10 each remote)		
		PH-SD	BA-SD	SF-SD	PH-BA-SD	PH-SF-SD	BA-SF-SD
10	4	6,212	-4,268	-9,948	6,468	788	-9,692
	8	23,840	2,880	-8,480	34,584	23,224	2,264
	12	41,460	10,020	-7,020	62,700	45,660	14,220
15	4	18,372	2,652	-5,868	25,548	17,028	1,308
	8	48,160	16,720	-320	72,744	55,704	24,264
	12	77,940	30,780	5,220	119,940	94,380	47,220
20	4	30,532	9,572	-1,788	44,628	33,268	12,308
	8	72,480	30,560	7,840	110,904	88,184	46,264
	12	114,420	51,540	17,460	177,180	143,100	80,220

Note: Table entries are student travel costs (values in Table E-4 times the number of convenings) minus the sum of VTT room costs and amortized computer equipment costs (Table E-3). Computer costs are for remote sites only. With 5 computers per site, two students per computer are accommodated at 10 students and a double-shift laboratory is required for 15 and 20 students. With 10 computer per site, one student per computer is accommodated at 10 students, half the students share computers at 15 students, and all students are two per computer at 20 students. Additional convenings could represent more than one course sharing the use of the same computers. Site abbreviations as per previous tables.

Appendix F

Student Questionnaire Summary Tables

Table F-1

Means, Standard Deviations, and Analysis of Variance Results for Student Questionnaire Rating Items.

Question	Mean		Std. Dev.		ANOVA	
	Local	Remote	Local	Remote	df	F
INSTRUCTORS						
1. Instructors were prepared & presented lessons clearly	4.40	4.27	0.54	0.60	1,98	1.24
2. Instructors encouraged class participation	4.56	4.54	0.50	0.61	1,98	0.05
3. Instructors answered student questions adequately	4.33	4.23	0.72	0.78	1,98	0.46
4. Instructors helped students who needed assistance	4.48	4.21	0.55	0.82	1,98	3.60
5. Instructors maintained adequate control of class	4.60	4.33	0.49	0.68	1,97	5.05*
LEARNING ACTIVITIES & TRAINING AIDS						
6. I could clearly see the instructional materials presented by the instructor	4.56	4.10	0.58	0.77	1,98	11.48**
7. I could clearly hear the instruction	4.62	4.48	0.53	0.54	1,98	1.80
8. The course provided skills that can be applied on the job	4.35	4.21	0.67	0.82	1,98	0.89
9. I had access to the instructors outside of class concerning the course content	3.96	3.47	0.87	1.08	1,97	6.03*
10. Instruction and demonstrations on completing the forms was adequate	4.17	4.04	0.81	0.87	1,97	0.57
11. Instruction & demonstration of computer procedures was adequate for computer lab	4.08	3.77	0.79	1.13	1,98	2.54
12. Paper and pen exercises were completed without problems	4.08	4.17	0.74	0.68	1,98	0.40
13. The computer laboratory was accomplished without problems	4.11	3.31	0.79	1.23	1,97	14.47**
14. Training aids were used effectively	4.44	4.25	0.50	0.68	1,98	2.42
15. Details of training aids could be clearly seen (for example, transparencies/graphics/forms)	4.56	4.06	0.50	0.70	1,98	17.01**
16. Table space and room layout were adequate to accommodate the use of computers	4.38	4.48	0.70	0.54	1,98	0.72

*p<.05 **p<.01

Five point scale for Items #1-23, #30, and #33-36 was:

[1] Strongly Disagree [2] Disagree [3] Neither Agree/Disagree [4] Agree [5] Strongly Agree

Four point scale for Items #24-28 was:

[1]-No problems [2]-Few problems [3]-Some problems [4]-Many problems

Table F-1 Continued

Question	Mean		Std. Dev.		ANOVA	
	Local	Remote	Local	Remote	df	F
INTERACTION/PARTICIPATION						
17. Interaction between instructors and students was adequate to support learning objectives	4.36	4.25	0.53	0.65	1,97	0.86
18. Student participation was sufficient to support learning objectives	4.35	4.35	0.60	0.52	1,98	0.01
19. Students aided one another in performing course exercises	4.33	4.35	0.56	0.56	1,98	0.01
20. Instructors gave equal attention to all students	4.48	4.10	0.55	0.89	1,98	6.58*
21. I hesitated to ask questions in order to clarify procedures or concepts	2.25	2.49	1.16	1.07	1,97	1.16
22. The ability of students to get help was adequate	4.43	4.10	0.54	0.80	1,97	5.65*
23. The course provided skills that can be applied on the job	4.21	4.14	0.62	0.93	1,98	0.21
EFFECTIVENESS OF PORTIONS OF COURSE						
24. Lectures were accomplished with:	1.52	1.83	0.65	0.81	1,98	4.29*
25. Laboratory exercises with paperwork were accomplished with:	1.65	1.81	0.63	0.77	1,98	1.31
26. Computer laboratory was accomplished with:	1.61	2.29	0.62	0.94	1,92	16.76**
27. Printing documents was accomplished with:	1.38	2.12	0.57	1.00	1,76	11.83**
28. Operating the computer program was accomplished with:	1.55	2.13	0.55	0.89	1,92	14.04**
BACKGROUND						
30. Before this course, I had basic knowledge of Quality Assurance concepts and forms	2.81	3.12	1.39	1.14	1,93	1.47
VIDEO-TELETRAINING						
33. Instructors coordinated activities among classroom sites effectively	4.23	4.24	0.66	0.56	1,96	0.01
34. Local and remote site classrooms participated equally in the class	4.12	4.18	0.81	0.72	1,96	0.13
35. Instructors called on students at all of the classroom sites about equally	4.50	4.30	0.50	0.54	1,96	3.55
36. The VTT facilitators assisting the instructor were helpful to students in the remote class	4.02	4.10	0.79	0.89	1,92	0.20

All items were rated on a five point scale except for Items # 24-28 where a four point scale was used:
[1]-No problems [2]-Few problems [3]-Some problems [4]-Many problems

Table F-2

Percent Response for Computer Background Questionnaire Items 31 and 32

Question and Answer Category	Treatment Group		
	VTT Local	VTT Remote	Combined Groups
Number of students responding	48	51	99
31. How would you rate your general skill or background in using computers:			
None/Beginner	14.6	27.5	21.2
Novice	22.9	19.6	21.2
Intermediate	37.5	39.2	38.4
Accomplished	16.7	9.8	13.1
Advanced	8.3	3.9	6.1
Total Percent	100.0	100.0	100.0
32. What is your level of typing or keyboarding skill:			
Hunt-and-Peck	18.8	15.7	17.2
Beginner	27.1	35.3	31.3
Intermediate	41.7	23.5	32.3
Accomplished	10.4	21.6	16.2
Advanced	2.1	3.9	3.0
Total Percent	100.0	100.0	100.0

Note: Percents exclude students who did not answer (one in each group).

Table F-3

Percentage Response Rate of Students in Each Treatment Group That Offered Comments to Open-Ended Questions (Items 43, 44, 45, 46, 47, and Computer Quiz)

Question and Group	Treatment Group		
	VTT Local	VTT Remote	Combined Groups
43. Take another VTT course	54.2	53.8	54.0
44. Liked most about course	72.9	59.6	66.0
45. Liked least about course	50.0	51.9	51.0
46. Problems during laboratories	22.9	48.1	36.0
47. Suggestions for improvement	39.6	36.5	38.0
CWP Computer Quiz "Remarks"	14.3	38.3	26.0

Note: percentages of total students that gave one or more comments to a question.

Table F-4

Percentage of Treatment Group Responses to Open-Ended Question 43 "If you had a choice would you take another VTT course?; Please explain"

Group and Comment Category	Treatment Group		
	Local	Remote	Combined
a. VTT benefits	20.0	17.5	18.7
b. Interaction	8.0	7.0	7.5
c. Miscellaneous positive toward VTT	2.0	14.0	8.4
a-c. Subtotal Positive Comments	30.0	38.5	34.6
d. Prefer traditional instruction	10.0	5.3	7.5
e. VTT problems	8.0	5.3	6.5
f. Miscellaneous negative comments	8.0	8.8	8.4
d-f. Subtotal Negative Comments	26.0	19.4	22.4
No Comment	44.0	42.1	43.0
Total Percent	100.0	100.0	100.0
Number of 1st Comments	26	28	54
Number of 2nd Comments	2	4	6
Number of 3rd Comments	0	1	1
Total Comments	28	33	61
Number No Comment	22	24	46
Total Comments and No Comment	50	57	107
Number of Students	48	52	100

Note: Divisor for percents was total of comments and no comment.

a. VTT Benefits: save travel, save money, expand training.

b. Interaction: positive comments on interacting with other students and locations by VTT.

c. Miscellaneous Positive toward VTT: VTT is good, liked good training, enjoyed VTT.

d. Prefer traditional instruction, live/local instruction.

e. VTT problems: Equipment/procedure problems with VTT system.

f. Miscellaneous negative comments: VTT confusing, need better facilitators, didn't like course, can't ask questions, don't like being watched, need larger class.

Table F-5

Percentage of Treatment Group Responses to Open-Ended Question 44
"What did you like the most about this course?"

Group and Comment Category	Treatment Group		
	Local	Remote	Combined
a. Novelty of VTT instruction	26.4	23.1	24.8
b. Computer and CWP hands-on training	24.5	21.2	22.8
c. Learning about Quality Assurance	20.8	11.5	16.2
d. Instructors	3.8	3.8	3.8
No Comment	24.5	40.4	32.4
Total Percent	100.0	100.0	100.0
Number of 1st Comments	35	31	66
Number of 2nd Comments	5	0	5
Total Comments	40	31	71
Number No Comment	13	21	34
Total Comments and No Comment	53	52	105
Number of Students	48	52	100

Note: Divisor for percents was total of comments and no comment.

a. Novelty of VTT instruction: interacting with other site, discussions, interesting, being part of new instruction, stay at one site, save money, time schedule was adjusted for both sites.

b. Computer and CWP hands-on Training: liked computer training, good labs, generating a CWP, hands-on exercises.

c. Learning about Quality Assurance: liked layout of materials, benefit to job, applies to job, made aware of safety.

d. Instructors: liked instructors.

Table F-6

Percentage of Treatment Group Responses to Open-Ended Question 45
"What did you like the least about this course?"

Group and Comment Category	Treatment Group		
	Local	Remote	Combined
a. Course materials	18.0	3.8	10.7
b. CWP computer program laboratory	4.0	7.6	5.8
c. Instructors or assistance	6.0	11.3	8.7
d. VTT problems	10.0	7.5	8.7
e. Waiting on other site	8.0	1.9	4.9
f. Classroom too hot	2.0	11.3	6.8
g. Class too early in day	0.0	9.4	4.9
h. Liked the course	4.0	0.0	1.9
No Comment	48.0	47.2	47.6
Total Percent	100.0	100.0	100.0
Number of 1st Comments	24	27	51
Number of 2nd Comments	1	1	2
Number of 3rd Comments	1	0	1
Total Comments	26	28	54
Number No Comment	24	25	49
Total Comments and No Comment	50	53	103
Number of Students	48	52	100

Note: Divisor for percents was total of comments and no comment.

a. Course Materials: Need more content, too much material, didn't learn anything new, vague, boring, looking in publications, jumping around manuals.

b. CWP computer program laboratory.

c. Instructors or assistance: Lack of help from instructors, not enough instructors, instructors read too much, materials not ready.

d. VTT problems: VTT limitations, equipment problems, microphones, distracting monitor, being on camera.

e. Waiting on other site: Waiting for other site to finish work.

f. Classroom too hot: air conditioning was broken, too hot in room.

g. Class too early in day.

h. Liked the course: positive rather than negative comment.

Table F-7

Percentage of Treatment Group Responses to Open-Ended Question 46 "Discuss problems encountered during the laboratories"

Group and Comment Category	Treatment Group		
	Local	Remote	Combined
a. Problems using CWP computer program	2.1	23.6	13.6
b. Computer link to printer	0.0	7.3	3.9
c. Need more computers	2.1	1.8	1.9
d. More instruction or laboratory time	10.4	1.8	5.8
e. VTT problems	6.3	5.5	5.8
f. Negative comment on assistance	0.0	5.5	2.9
g. Positive comment on assistance	2.1	5.5	3.9
No Comment	77.1	49.1	62.1
Total Percent	100.0	100.0	100.0
Number of 1st Comments	11	25	36
Number of 2nd Comments	0	3	3
Total Comments	11	28	39
Number No Comment	37	27	64
Total Comments and No Comment	48	55	103
Number of Students	48	52	100

Note: Divisor for percents was total of comments and no comment.

a. Problems using CWP computer program.

b. Computer link to printer caused problem.

c. Need more computers.

d. More instruction or laboratory time: need more instruction, not enough time on computers, not enough time on laboratory paper work, not familiar with publications or terminology.

e. VTT problems: VTT equipment problems or communication line down.

f. Negative comment on assistance: facilitator not present or knowledgeable, laboratory papers not available.

g. Positive comment on assistance: instructor or facilitator helped, working together helped, few problems encountered.

Table F-8

Percentage of Treatment Group Responses to Open-Ended Question 47 "Discuss any suggestions you have for improving the course"

Group and Comment Category	Treatment Group		
	Local	Remote	Combined
a. Improve content or delivery	24.5	11.1	17.8
b. Improve CWP computer program	0.0	14.8	7.5
c. Resolve equipment problems	7.6	9.3	8.4
d. Improve facilitator assistance	0.0	3.7	1.9
e. Prefer traditional over VTT instruction	3.8	0.0	1.9
f. Positive comment on instructor, course, or VTT	9.4	0.0	4.7
No Comment	54.7	61.1	57.9
Total Percent	100.0	100.0	100.0
Number of 1st Comments	19	19	38
Number of 2nd Comments	4	2	6
Number of 3rd Comments	1	0	1
Total Comments	24	21	45
Number No Comment	29	33	62
Total Comments and No Comment	53	54	107
Number of Students	48	52	100

Note: Divisor for percents was total of comments and no comment.

a. Improve content or delivery: improve content, better or more materials, improve instructor time schedule and procedures, have materials ready, more hands-on, give students copy of CWP program to take to ship.

b. Improve CWP computer program: improve software, make program easier.

c. Resolve equipment problems: VTT equipment, speakers or microphone quality, show video of local students.

d. Improve facilitator assistance: more involved facilitator.

e. Prefer traditional over VTT instruction.

f. Positive comment on instructor, course, or VTT: Good course or instructor, expand use of VTT to deliver instruction.

Table F-9

Percentage of Treatment Group Responses to Open-Ended Question for "Remarks" on CWP Generator Computer Quiz/Questionnaire

Group and Comment Category	Treatment Group		
	Local	Remote	Combined
a. Software issues	0.0	28.8	14.4
b. Positive comment on course or computer program	17.3	7.7	12.5
c. Miscellaneous dissatisfied	1.9	7.7	4.8
No Comment	80.8	55.8	68.3
Total Percent	100.0	100.0	100.0
Number of 1st Comments	7	18	25
Number of 2nd Comments	2	4	6
Number of 3rd Comments	1	1	2
Total Comments	10	23	33
Number No Comment	42	29	71
Total Comments and No Comment	52	52	104
Number of Students	49	47	96

Note: Divisor for percents was total of comments and no comment.

a. Software issues: Software not friendly, hard to print CWP, want to use WordPerfect, needs file merging, don't have computer experience, need more training on CWP program, need user guide for program.

b. Positive comment on course or computer program: good course, good or useful computer program, want program for ship.

c. Miscellaneous dissatisfied: instruction too short, VTT connection went down during lab.

Distribution List

Chief of Naval Operations (Code N813)
Office of Naval Research (Code 03B) (3)
Chief of Naval Education and Training (Code 00), (N2), (N5), (L01) (12)
Chief of Naval Personnel (PERS-00H), (PERS-05)
Commander, Naval Sea Systems Command (Code SEA 09)
Commander, Naval Reserve Force, New Orleans (Code 00)
Commander, Training Command, U.S. Atlantic Fleet (Code N3)
Commander, Training Command, U.S. Pacific Fleet (Code N-31)
Commanding General, Marine Corps Combat Development Command (MCCDC), Quantico (Code C46), (C46MS)
Commanding Officer, Naval Education and Training Program Management Support Activity (Code 04) (2), (Code 03EE1) (2)
Commanding Officer, Naval Sea Logistics Center (Code 11)
Commanding Officer, Fleet Anti-Submarine Warfare Training Center, Atlantic
Commanding Officer, Fleet Anti-Submarine Warfare Training Center, Pacific
Commanding Officer, Submarine Training Facility, San Diego
Commanding Officer, Fleet Combat Training Center, Atlantic (Code N713)
Commanding Officer, Fleet Training Center, San Diego (Code 00), (021.2)
Commanding Officer, Fleet Training Center, Norfolk (Code 00), (CISO)
Commanding Officer, Navy Air Warfare Center, Training Systems Division (Technical Library) (Code 72) (5)
Commanding Officer, Sea-Based Weapons and Advanced Tactics School, Pacific
Superintendent, Naval Postgraduate School
Director of Research, U.S. Naval Academy
Center for Naval Analyses, Acquisition Unit
Director, Defense Personnel Security Research Center
Director, Army Research Institute (PERI-ZT), (PERI-II), Alexandria
Director, Human Resources Directorate, Armstrong Laboratory (AL/HR), (AL/HR-DOKL Technical Library), Brooks Air Force Base, TX
Headquarters, Air Education and Training Command (AETC/XORR), (AETC/TTP), Randolph Air Force Base, TX
Pentagon Library
Defense Technical Information Center (DTIC) (4)